SEVENTY-FOURTH YEAR

SCIENTIFIC AMERICAN

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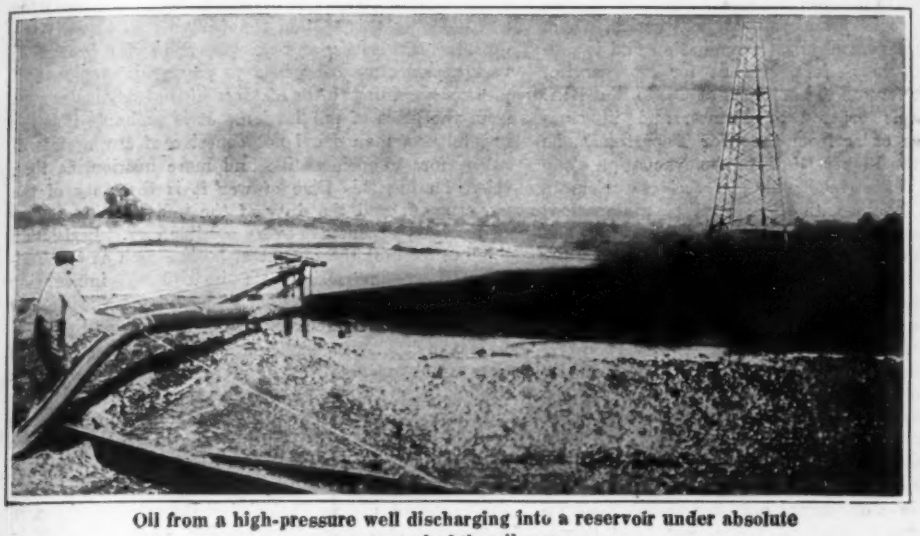

Oil from a high-pressure well discharging into a reservoir under absolute control of the oil men

Black oil from a Sinclair well in the southwest, flowing into a lake reservoir

Our Wartime Barrel of Oil

THAT we are a wasteful people is an old, old story. Altogether, it is not our fault; for any people blessed with a super-abundance of everything such as we have enjoyed in a practically virgin land, would also be wasteful. But in the new order of things brought about by the great war, we are coming face to face with the question of economy in many different directions. One of these is gasoline, which, we are told, must be conserved, for the supply is by no means inexhaustible as things now stand.

Our national wastefulness has had full sway in the matter of petroleum, from which is derived gasoline and kerosene and other fuel oils. There has been wanton wastefulness in production methods, processes of refining, ways of utilization, and methods of storing. Indeed, so great has been the wastage since Colonel Drake drilled the first oil well back in 1859, that we are now confronted with the stern fact that at the present rate of consumption there will be no petroleum resources in this country in 30 years from now.

So the question of petroleum is brought to the front in a most vivid manner just now, and because of its extensive use in many different industries and in our home life, it is a matter of universal interest. Petroleum, in certain refined forms, means light and heat to many people. To others it means cheap and reliable power for driving the shop or ice machine or dairy equipment. To the farmer it means a sure substitute for the horse, in the form of gasoline tractors which are doing so much in the way of avoiding a world-wide famine. In business, gasoline means quick and reliable transportation means. And above all, there are some five million automobiles employed by business men, doctors, inspectors, and home folk, as a means of getting about the country. The automobiles alone require a minimum of two billion gallons a year.

A great gusher spouting black oil at Goose Creek, Texas

Until the present, wastage of petroleum has been largely at the production end and in big measure due to lack of Government control. Often the oil men, bent on procuring suitable supplies of petroleum in the most expeditious manner, have allowed valuable sources of natural gas to go to waste, either through lack of a profitable market close at hand or through disinterest. In the records of the Bureau of Mines one finds many startling accounts of natural gas wastage. For instance, in the Cushing field a natural gas source was allowed to dissipate itself in the air at the rate of 14,000,000 cubic feet a day for 67 days, or a total of 938,000,000 cubic feet. Another instance is cited, in which 40,000,000 cubic feet were wasted daily for seven days.

While the natural gas wasted in either case could have been stored and sold at a price running into the tens of thousands of dollars, the oil men did not think it worth while. Yet their procedure wasted gas which had a fuel value equivalent to 61,000 tons of coal. Legally, the gas belonged to the oil men and was theirs to do

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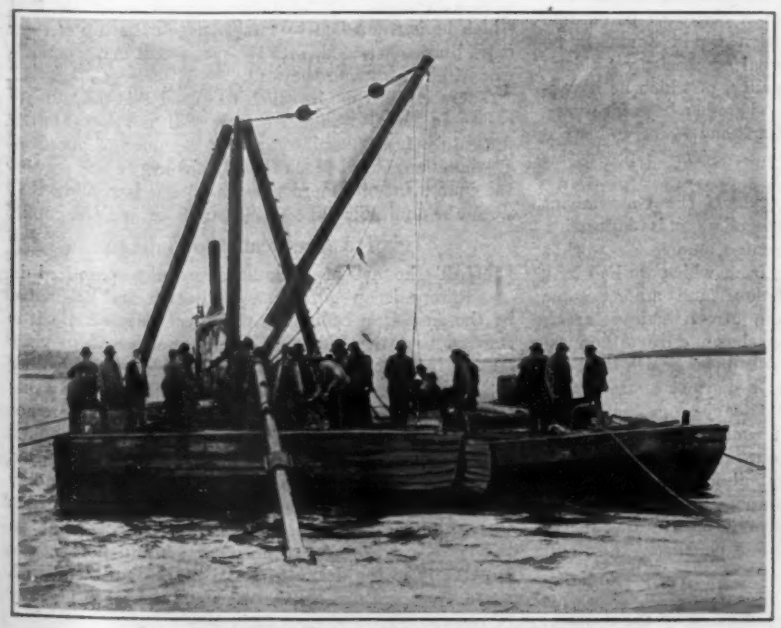
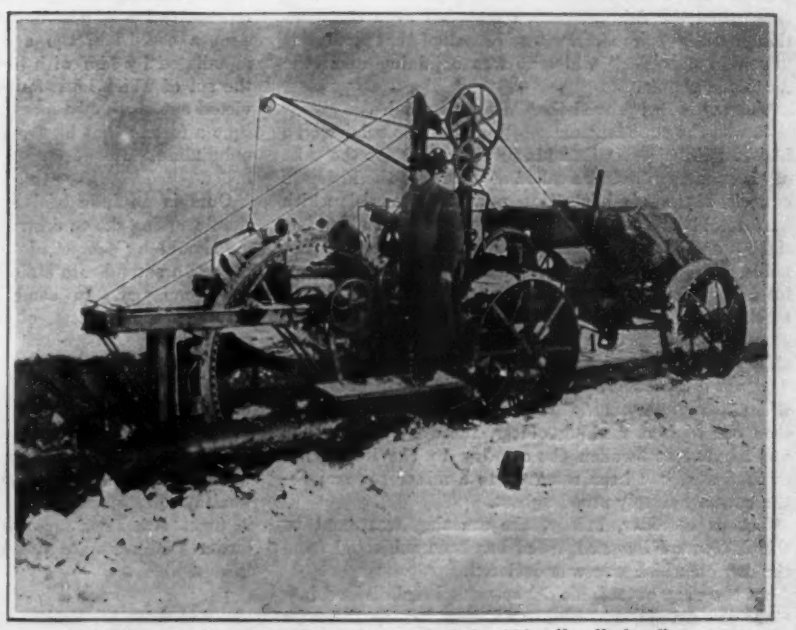


Laying the 800-mile oil pipe line under the Mississippi River



Ditching machine at work on the route of the 800-mile oil pipe line

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Amazing Case of General Wood

IN such a serious hour as the present, when the United States is passing through the greatest crisis in its history, it would ill become the SCIENTIFIC AMERICAN to indulge in captious criticism of the War Department, or call in question, for one moment, the purity and disinterestedness of its motives.

At the same time it is our bounden duty, as one of the oldest and most conservative organs of American opinion, to draw the attention of the War Department to the fact that its treatment of General Wood carries on the face of it a suggestion of discrimination and discourtesy, so palpable and disconcerting, that it may well disturb the confidence of the country at the very time when public confidence and public morale are of supreme importance.

For General Leonard Wood is not merely an American and a soldier; he is an American of the Americans, and a soldier whose professional career has been an unbroken series of successes—administrative, diplomatic, and military. Not only is he the ranking general of the American Army, an officer of proved and universally admitted ability, but by the sheer force of his character and the fine quality of his patriotism, he has become one of those really representative Americans who are as greatly honored in the Old World as in the New.

That General Wood has been successful both as a soldier and an administrator is proved by his record. Serving first as Colonel and then as Brigadier-General and Major-General of Volunteers in Cuba, he was appointed at the close of the Spanish War the first Governor General of the Island. Under his four years regime (1898 to 1902) he brought order out of chaos and left that country peaceful, prosperous and friendly to the United States. Then we find him, as Commanding General, doing similar reconstructive work in the Philippines. Following this service, he was stationed at Governors Island as Commander of the Department of the East, and at Washington as Chief-of-Staff. During his tenure of this office (1910 to 1914) he reorganized the General Staff, and under him it functioned better than ever before in its history.

In 1914 he became again the Commanding General of the Department of the East, a post which he held until the United States entered the war—when he was summarily demoted.

General Wood has ever been the great protagonist of military preparedness. Long before the European War, as Chief-of-Staff, he drew attention to the weakness of our military system; and when the great catastrophe burst upon the world, he sounded the alarm with a trumpet voice. It took no little courage to do this at a time when the Administration regarded even the mention of military preparation as a breach of that neutrality "even in thought," which it was enjoining upon the American people.

The event has proved that Wood was right.

It was the confident expectation that the soldier who had so nobly jeopardized his future career for the sake of his country, would be called at once into the intimate councils of the Administration, now that the crisis which he foretold had actually come upon us. An able, far-sighted and highly experienced General, such as he, who holds, also, the affection and unbounded confidence of his fellow citizens, is surely, at such an hour as this, a most valuable asset to his country; and we take it that no other questions than those of his record and his proved ability should determine the degree of his employment.

Hence it came about that, when in the same breath in which it was announced that we were at war, we were told that our highest ranking officer, the very soldier who had labored to awaken the country to the imminence of that war, had been removed to a minor command—the country simply stood aghast.

Let us consider, briefly, the amazing treatment to which General Leonard Wood has been subjected from the day on which war was declared.

At the very outset, his department is subdivided into three commands, and he himself is assigned, without a word of explanation, to the least important of the three; and, as if in fear lest he should miss the full significance of the slight, he is offered as an alternative the command of the Hawaiian Islands. He elects to remain in America and proceeds to Charleston, where the good people of the South, who perfectly well understood what had been done to this splendid American, turn out en masse and receive him with public acclamation. Thereafter, his tour of duty through the South takes on the character of a triumphal progress. He is met by successive delegations of the citizens. At Atlanta over sixty thousand people gather to see and hear him, and at Little Rock, Arkansas, an equal number.

After three months in the South, he is appointed to train and command the Eighty-Ninth Division of the National Army at Camp Funston. On reaching Kansas City, there is another outpouring of the citizens to pay tribute to the man and the soldier. Next, we find him in France on a trip of observation and instruction. He is wounded; recovers; and returns to America, where he undergoes a severe physical examination and is pronounced physically perfect, and fit for any service, anywhere. He returns to his troops at Camp Funston.

His division is ordered to France, and in compliance with an order from the War Department, he proceeds with the Eighty-Ninth to the evacuation camp at Mineola. On the eve of sailing he receives a telegram relieving him (again without a word of explanation) from the command of his division and assigning him to the Western Department at San Francisco. Here he would have been effectually shut out from any active share in the war, and, apparently discredited by the Administration, he would have found himself condemned to mere routine work.

The outburst of indignation throughout the country, which included a dignified letter of protest from Ex-President Taft, has resulted in the reassignment of General Wood to Camp Funston.

There is a widespread feeling that, in separating him from his command and in shutting him out from any active service in Europe, not only has an enormous injustice been done to General Wood, but (and this is even more serious) the country has been deprived, during this great military crisis, of the services of one of its ablest generals.

President Wilson has uttered many inspiring and noble thoughts during the past few weeks, and none of these has struck a more responsive chord in the heart of the American people, than when he reminded them that there was no place in this war for politics or personal feeling.

The Zone Postal System and Mr. Kitchin

THE Civil War prevented this house of ours from being permanently divided against itself. The Union was preserved; North, South, East and West continued to fly one flag and the United States of America was happily perpetuated. Since the termination of that conflict, it is probable that the people of this country were never as united in fact and in spirit as they are at the present moment. Sectionalism, with all the term implies, has been swept away. One of the few good results that have been brought about by the present gigantic struggle is the further consolidating of different sections of the country into one amalgamated whole. Any member of Congress who raised his voice in an effort to destroy this fabric, or in defense of sectionalism with the curse that it placed upon our people, would be greeted with derision, and would be considered as an enemy of Society and of the Republic.

The astonishing accusation of conspiracy, brought by Claude Kitchin a few days ago was a startling revelation in its untimeliness. If any one should accuse this representative of the South of a desire to perpetuate such a condition, the accusation would doubtless be repudiated by him with his usual emphasis; yet this is the act of which he is found guilty, of which he is convicted out of his own mouth. There has been for a long time a feeling that he was not a friend to our industrial upbuilding. His recent utterances seem to prove this belief.

Ours is an industrial country. If the Government should undertake to destroy or embarrass its industries, we should be compelled to resume among the world's powers a second-rate standing from which we had long since emerged. In some sections and among some members of Congress, of whom Mr. Kitchin is a fair representative, there has been shown during the past few years an uneasiness in regard to the wealth that this country was accumulating and a distrust of those who were accumulating it, with a tendency to promote legislation which, if carried to its ultimate conclusion, could only bring about a curb upon our industrial growth that would be destructive to the upbuilding of the commonwealth. Industrially this country cannot stand still; it must either go forward or fall backward. If the business interests are attacked and penalized, the result is inevitable.

In the present instance, Mr. Kitchin's attack is directed primarily against the publishers of the country. He has not been a popular figure to be sure, but has he not deserved the criticism which has been passed upon him many times by the American press? If his attitude now toward those who stand behind our press is due to any vindictiveness on his part, it simply confirms a belief that has long existed. The publishers on the whole are among the most respected and reputable of our citizens. Why, therefore, should their business, which is now suffering from singular and unprecedented causes, be made the victim of special attack and destructive legislation? The accusations which he has brought against the publishers as such are not only directed against them but also cast imputations against the character and standing of the Secretary of the Treasury and indirectly upon the President himself.

The press has had much to say during the past year or more in regard to that part of the Revenue Act known as the Zone System of Postal Rates. It is too well understood by the people at large to need any elucidation here. Under this system the United States is divided up into eight zones, and the papers passing into those various zones are compelled to pay a different rate of postage according to the distance of that particular zone from the place of publication. It is probable that the ingenuity of man could not conceive of any system of rates more unbusiness-like and more unscientific than this. During this time of war it is the duty of the Government and the duty of the individual to reduce unnecessary expenses in every possible way. Legislation tending to limit the output of labor—such as the Full-Crew Law—increases costs instead of introducing economy. The zone system of postal rates is another step in the same direction; and it appears as though it were a method of penalizing a particular section at a time when business is least prepared to bear any such burden.

It is, perhaps, not well understood by the legislators who passed this Act how enormously the Post Office force must be increased to carry out its provisions. Perhaps it is not well understood by them that in order to fulfill the exactions of the Post Office Department the publishers are also obliged to employ extra labor. It is, in fact, doubtful whether this provision, had it been brought up separately and with a full understanding of all the conditions, would have been passed by Congress last year. It is far more doubtful whether it could be passed now. The point which should be sternly looked at with an unswerving eye is whether such a law as that which has been enacted is a desirable law for the country at large; whether the individual who lives far from the publishing center should be penalized because of such unfortunate residence. Is it fair that one part of this country should be specially favored owing to its central location at the expense of another part which is more remote? Is it fair that at this time awkward and improper methods of mail distribution should be provided when the ordinary distribution under normal conditions is unsatisfactory and the cause of many complaints? The Post Office Department at the present moment is not able to handle the business which is entrusted to it. This is due to perfectly natural causes—the high cost of labor, the difficulty of getting labor at all, the many enlistments and the general disorganization following in the wake of war. Is this a proper time, therefore, to enforce new and severer conditions which would tax the Department to the breaking point?

Perhaps there is some other motive. Possibly it is to punish a particular class of citizen. It should be pretty well understood by this time how enormously the cost of the publishing business has increased during the past few years. The price of paper is almost double, the cost of printing has risen by leaps and bounds, the cost of labor has affected the publisher as it has all classes of industrialism. He is staggering now under the load which he is compelled to carry, and on the top of that, extra burden is added, with the result that many periodicals will be forced to the wall.

There is still time in which to repeal this unfortunate clause in the Revenue Act. It will not be enforced until July 1st. The intemperate language of one Congressman ought not block the path of justice nor prevent the enactment of a more sound and sane law, a law that would be equitable alike to the publisher and the public.

Native American Camouflage

THAT the art of camouflage as now practiced in Europe is an American institution and originated by the American Indians is the latest suggestion. It is claimed that the Indian children were taught to place flowers in their hair as well as twigs, leaves and other bits of foliage, and that they were able to move along the ground in such a stealthy manner that they were not discernable to the rest of the tribe.

Before a young buck could become qualified as a warrior, he had to make his approach to the Indian camp almost in the midst of the assembled warriors without being detected. The real origin of paint on the faces, as well as on the wigwams and horses, was apparently in the desire to make the Indian blend with rocks, trees and dirt, so that he could approach his prey or remain hidden without detection.

Electricity

Aluminum in Transformers.—Aluminum has been suggested as a substitute for copper in transformer windings. Dealing with heat dissipation, temperature rise, comparative costs of the different materials and other important factors, it appears that the advantages are still with copper, however.

One Hundred and Sixty Five Million Tungsten Filament Lamps were sold in the United States for the year 1917, or an increase over the previous year of about fourteen per cent. These figures exclude miniature lamps, of which more than 75,000,000 were sold, or representing an increase of about forty per cent. It is of interest to note the steadily decreasing use of carbon filament lamps. Some eleven years ago carbon lamps represented nearly one hundred per cent of the total lamps sold, while last year the carbon filament lamps amounted to only 12 per cent of the total.

Rectification of Alternating Currents by the Corona.—The rectification of high voltages is an interesting problem, on which some experiments described by Mr. J. W. Davis in a recent paper read before the American Physical Society shed some light. Pressures as high as 42,000 volts have been rectified by the corona discharge in hydrogen. For a given gas pressure the maximum voltage which may be rectified is roughly proportional to the radius of the outer cylinder, provided that the inner cylinder is small compared with the outer. The rectification is practically perfect; but the efficiency is low, much energy being wasted in the discharge. The voltage at which discharge takes place may be considerably reduced by arranging for the discharge to be started by an incandescent wire.

Railway Electrification and Coal Saving.—Mr. E. W. Rice, President of the American Institute of Electrical Engineers, recently referred to the value of railway electrification as a possible future opening for coal-saving in the United States. Much had been said on the economizing to be made by cutting down lighting, which, however, was only responsible for two per cent of the total coal consumption. But the consumption by steam driven railways amounted to 25 per cent of the total coal mined, and the coal was used under such inefficient conditions that six pounds were required per horse-power-hour. Electric traction could boast an efficiency three times as high. Accordingly, if all railways were converted to electricity a saving of 16⅔ per cent of the total coal consumption could eventually be made—far more than could be achieved by suppressing lighting altogether.

Anti-Shock Aerials for Ship's Wireless.—According to *The Electrician* of London, there has recently been patented by a Mr. S. Hall an invention which reduces to a minimum the risk of wireless aerials on vessels being broken and the wireless apparatus thus put out of action when a ship becomes mined or torpedoed. The invention is stated to be simple and inexpensive, and utilizes one or more long extension springs specially constructed and fitted at each end of the present aerials, these springs automatically extending and contracting to allow the aerial to lengthen or shorten to take up the varying distances between the top of the masts when they spring out of position through an explosion. These springs do away with the present necessity of lowering the aerial when a ship is being loaded, as they allow for the vibration of the masts caused by working the derricks, and their use would in some cases save the aerial being blown away by shell fire.

Ventilated Motors During a Strenuous Winter.—The excessive troubles and breakdowns experienced during the past severe winter season with car equipment suggest the following questions with regard to the motors: (1) To what extent is the introduction of the ventilated type of railway motors responsible for breakdowns? (2) What can be done with regard to operation and maintenance to avoid a recurrence of the recent experiences in connection with the motors? (3) Is the ventilated motor a practical proposition and is it destined to survive? The following conclusions were the ones reached, according to R. E. Hellmund in *Electrical Railway Journal*: That a certain amount of damage is done to the motor equipment owing to the dampness within the motor caused by snow and water conditions. The older so-called ir closed motors suffered more than the ventilated motors. Much of the snow causing the damage to the motor entered through the top commutator opening on account of missing or badly fitting commutator covers. Ventilated motors for a given continuous rating weigh less than non-ventilated motors and absorb less heat. Under ordinary operating conditions this is of little consequence, but under emergency conditions such as obtain while cars are bucking snow drifts, pulling disabled cars home, etc., the ventilated motor, if worked to the limit of its continuous rating, is more liable to roast out than the old non-ventilated type. The extra weight of the latter and the larger mass can temporarily absorb, during heavy overloads of short duration, a certain amount of heat which tends to prevent overheating. A number of failures of ventilated motors have also occurred where the cars have been overmotored.

Science

A Meteorological Service for the Navy has recently been organized as a branch of the Naval Air Service and placed under the direction of Prof. A. G. McAdie, director of the Blue Hill Observatory, who has been commissioned a lieutenant commander in the Naval Reserve. A number of young men from the Massachusetts Institute of Technology and other institutions have been commissioned ensigns and are serving under Lieut.-Commander McAdie.

Electrical Rules for Mines.—The "Suggested Safety Rules for Installing and Using Electrical Equipment in Bituminous Coal Mines," recently published by the U. S. Bureau of Mines, had been in course of preparation for more than three years. The rules were reviewed by committees of the American Institute of Electrical Engineers, and formally recommended by that body for trial. A modified form of this safety code has been submitted to the New York Industrial Commission with the suggestion that it be adopted in that state.

A Meteorological Glossary has recently been published by the Meteorological Office in London, having been called forth especially by the necessity of supplying a handbook of meteorological information for the use of the army and navy. Although the number of terms defined in this work is comparatively small, and many of them pertain primarily to physics and not exclusively to meteorology, the information is presented in encyclopedic form, with illustrations, diagrams, etc., and constitutes a unique contribution to meteorological literature.

Ozone for Frost Protection ?—While the amount of ozone in the lower layers of the earth's atmosphere is now known to be negligibly small, this substance is abundant in the upper atmosphere, where it plays an important role in regulating terrestrial temperatures by its absorption of radiation. Dr. C. G. Abbot, of the Smithsonian Institution, has recently suggested that if it were possible to charge the lower air above citrus fruit orchards, for example, with a heavy dose of ozone its absorption of outgoing nocturnal radiation might help ward off destructive frosts.

Plants from Afghanistan.—His Highness the Amir of Afghanistan has presented the U. S. Department of Agriculture with a remarkable collection of dried fruits and seeds representing varieties of tree and field crops grown in his country. Especially interesting, says a report of the Bureau of Plant Industry, are samples of dried white mulberry, which is one of the principal articles of food in Afghanistan. They are ground and made into a flour, which is mixed with ground almonds. The Bureau suggests that a sweet, drying variety of mulberry might be worth considering for the Great Plains region of the United States.

Nellore Cattle in the Philippines.—Rinderpest still constitutes one of the chief economic problems of the Philippines and is the subject of constant investigations on the part of the colonial Bureau of Agriculture. A considerable increase in the prevalence and virulence of the disease has been reported during the past two years. Recently it has been hoped that the solution of the problem might be found in the introduction of Nellore cattle from India. These animals are known to be highly resistant to rinderpest, and it was believed that the same immunity would be found in the grades resulting from crossing Nellore animals with the native stock. From a recent report by Chief Veterinarian Stanton Youngberg it appears that this hope was illusory. Nellore cattle have been introduced in considerable numbers since 1909, and prove themselves well adapted to the climate and otherwise valuable. The pure stock is highly resistant to rinderpest, though not quite immune, but the grades due to crossing with native cattle show little more resistance than native stock.

Land Magnetic Work of the Carnegie Institution.—In his last annual report Director L. A. Bauer reports that, in spite of war conditions, some important magnetic surveys of land areas were made by the Carnegie Department of Terrestrial Magnetism during the year ending October 31st, 1917. Mr. H. E. Sawyer led an expedition through French Kongo to Lake Chad, and thence eastward to the Anglo-Egyptian Sudan; Mr. F. Brown made surveys in various parts of China; Messrs. W. F. Wallis and W. C. Parkinson made observations at several points in Australasia in connection with the establishment of a magnetic observatory in Western Australia; and a number of expeditions were carried out in South America. The site finally selected by the Carnegie Institution for its magnetic observatory in Western Australia is about ten miles west of Watheroo and 120 miles north of Perth. The colonial government made a grant of 160 acres for the building-site of the observatory, with two additional 10-mile strips, one rod wide, for burying cables to be used in investigations on earth-currents. The observatory is in course of construction and was expected to begin work early this year. After considerable search in Peru, the Institution has decided to build an observatory near Huancayo, 150 miles east of Lima, at an elevation of 11,000 feet.

Industrial Efficiency

That Loose Shoe String.—Little things often lead to serious consequences. So it is not surprising to learn that recently an employee of a large manufacturing establishment was coming down the stairway from the third floor of the warehouse, when the lacing in one of his shoes became untied. He continued to go down the stairs, and when about five steps from the landing he stepped on the flowing shoe lace, which threw him, and he fell, striking his head and shoulders on the bottom step with such force that he died the next morning. Which teaches us that one cannot afford to be careless, even in such trivial details as loose shoe strings.

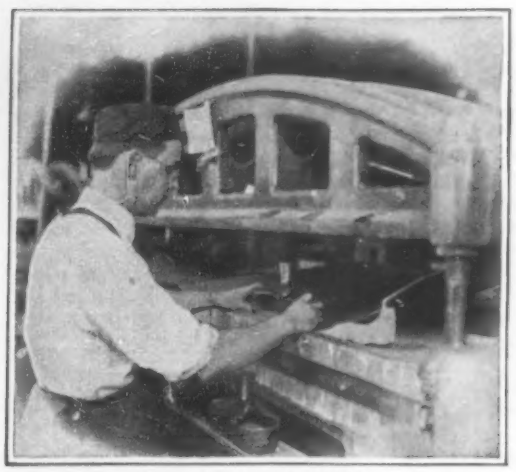
Applied Science in the French Academy.—It is significant of the spirit of the times that the French Government has created, at the suggestion of the Academy of Sciences, a new division in that body, under the title "Application of Science to Industry." The new division of the Academy will consist of six members, who are to enjoy the same privileges as the "free members" (not attached to any section), without restriction as to residence. It is intended that the six new members of the Academy shall be chosen from among those persons in the industrial world who have achieved important scientific advances in their several lines and made the results public.

War Work for 20,000 Women.—Approximately 20,000 women have been placed in positions through the Federal Employment Service since February 1st, according to Mrs. Hilda Muhlhauser Richards, chief of the woman's division. This figure is based on reports turned in by Federal employment offices and their co-operative agencies for February and March. Munition factories received the greatest number of the women workers supplied by the Federal service, the reports show. The majority of women applying for employment ask for work in the war industries. Nearly every city in the country, it is stated, reports difficulty in obtaining women for housework and other branches of domestic service.

Operating Motor Boats with Fish Oils.—According to the *Politiken* of Copenhagen, experiments have been made with motors for fishing boats to determine the practicability of using fish oils for operating motors. It is said that this has proved a success, and that it may be possible for the fishermen who now have boats equipped with kerosene motors to make some slight changes which will enable them to operate with fish oil. It is then proposed that the fishermen may make their own cod-liver oil while on the sea for use in their motors. Experts who have studied the question claim that there is no reason why fish oil cannot be used in the present explosive motors, although it may be that certain changes have to be effected in them. However, in the case of Diesel motors there should be absolutely no trouble.

Shoes without Leather.—A new industry caused by the war and started in the southern part of Holland is attracting general notice and will probably spread over the entire country. It is the making of a slipper with a wooden sole and with the upper and inner parts formed of various materials, such as twill, corduroy, and cheap woollen stuffs. All these materials are relatively cheap and yet make comfortable and durable slippers, selling for the practical equivalent of $1 a pair for the best quality. It is claimed that they can be used generally where the occupation is indoors. Their cheapness is particularly appealing in view of the prohibitive prices toward which shoes and slippers in shops are steadily mounting. Excepting the cutting of the wooden sole, which is done by machinery, these slippers are made by hand.

Fatigue Studies Among Female Workers.—The U. S. Public Health Service has coöperated with the Wisconsin Industrial Commission in obtaining data upon which the hours of employment for women might be fixed under the state law providing that such working hours "shall not be prejudicial to their health, safety or welfare." A survey has been made of 141 establishments, representing nearly every industry employing female labor. A special study was made of the fatigue curve in women engaged on various kinds of piece work, as reflected in the hourly production. The most striking fact brought out by these studies was the large amount of time lost by voluntary interruptions of labor, of one kind or another, in the case of the long as compared with the short working day. In the 10-hour industries these losses averaged 14 per cent. It is believed that these time losses are protective or defensive measures instinctively practiced by the operators in order to ward off the accumulation of fatigue. The results of the studies in question led the manager of one establishment to place a number of his operatives on an eight-hour day, with the result that in a short time the workers attained and slightly exceeded the previous output of a nine-hour day. This paradoxical result is quite in accord with those obtained elsewhere in the United States, as well as in the British munition factories. Long hours of labor are disadvantageous to the employer as well as the employed.



Cutting soles from beef hides

Pulling the upper into position over the last

Sewing the welt to the upper and insole

Shoes for Soldiers

Revising the Professional Fighter's Footwear to Make It Fit the Citizen's Army

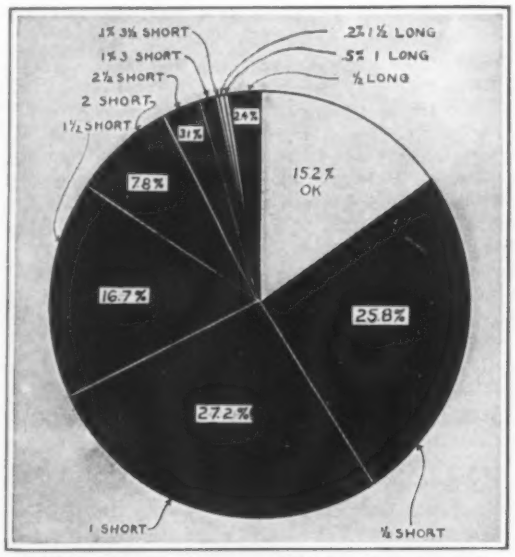
By Arthur L. Dahl

SOLDIERS burning with the spirit of patriotism can fight in their bare feet, as was demonstrated at Valley Forge; but under normal conditions it is just as essential to have our fighters well shod as to have them well armed. When a man's feet hurt it is not so easy to keep up enthusiasm, and Uncle Sam is doing his utmost to see that all the boys who train for service abroad are well shod. This is not as easy as would seem, for some very interesting facts were disclosed by a recent series of tests made at a number of military camps in this country. During these tests, which were under the direction of Mr. Elmer Jared Bliss, a practical shoe man of Boston, more than 42,000 men were measured for shoes, and a scientific plan was worked out for fitting men with the size and kind of shoe each should have. A new schedule of sizes has also been arranged to approximate more closely the conditions found to exist in the different training camps.

When the mobilization of our fighting forces started, and hundreds of thousands of men of all sizes and weights were sent to the various training camps, the system under which they were supplied with shoes was based upon the schedule of sizes on which shoes had been ordered for the small professional army previously maintained by the United States. This called for a certain number of pairs of shoes of a certain size, ranging, in a unit of 10,000 pairs, from a few pairs of the smallest and largest sizes, up to 1,594 pairs of size 8.

This schedule worked very well for the small regular army, but it did not meet the requirements of the enlarged army. At the request of the Government, Mr. Bliss organized a corps of expert shoe men and investigations were made at military camps at El Paso, Tex., South Framingham, Mass., Quantico, Va., and Ayer, Mass., and a total of 42,000 men measured and fitted for shoes. As a result of these investigations it was found that out of 32,395 men examined by Mr. Bliss' staff, 27,981 were wearing shoes varying from one-half to three and one-half sizes too short. Thus 80 per cent of the soldiers were improperly shod. This result was not due to any fault on the part of the men in charge of the Supply Depots, but was brought about by five principal causes reported by the investigators: Lack of experience on the part of the men who really issue the Army shoes, ignorance and vanity of the men who wear the shoes, discrepancies between the sizes marked and the actual measurements of the shoes, lack of proper sizes due to radical errors in present method of ordering and distributing sizes and widths, and the fact that many men who were ignorant of army standards of oversize shoes or who disliked these standards were fitted on their own estimate of the size worn in civil life.

It was found that almost universally the men asked for and insisted upon wearing shoes that under army conditions were not large enough; and the investigators decided it was absolutely necessary to devise a measuring



Soldiers of a typical group called for shoes from 3½ sizes short to 1½ sizes long, as here shown

outfit which would protect the wearer against his own ignorance and vanity and against the manufacturers' variations in sizes. This device should also be simple enough to be understood and easily operated by inexperienced shoe-fitters, and enable them to make a quick, positive and correct decision which would satisfy the wearer. After much thought and many experiments, a device was perfected which will accurately and quickly decide the size of shoe each man should wear, and it is intended to supply each distributing station with one of these outfits to facilitate the work of each shoe clerk. The Bliss Committee also worked out a new schedule of Army shoes, based on the demands of the thousands of men actually fitted, and this new schedule calls for a greater number of shoes of each size so that a larger variety of sizes will be available from which to fit the men. It is also proposed to put practical shoe men in charge of each shoe depot to see that the soldiers get the kind of shoes they should have rather than the kind of shoes they would choose for themselves.

During the first year of the war the government has purchased in the United States approximately 20,000,000 pairs of Army shoes, at an average price of $5 per pair, or a total expenditure of one hundred million dollars.

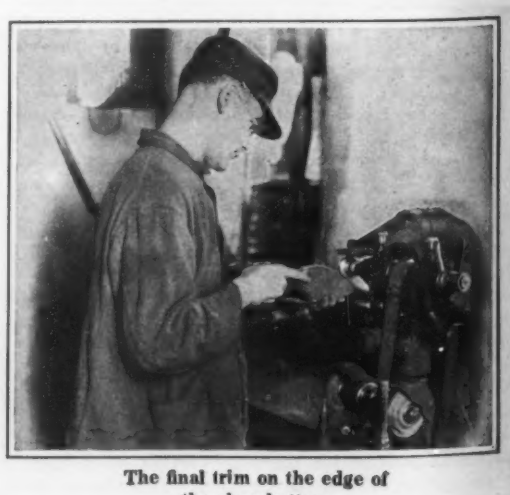
The first Army shoes contracted for after we entered the war had uppers made from a chrome retanned hide which, while perfectly satisfactory for service in this country, proved to be unequal to the conditions of trench warfare in France. Consequently, the new trench shoes are being made with a much heavier upper cut from the best bark-tan natural-color cowhide or kip. These hides are from a fully matured animal and are consequently of the strongest possible fiber. They are commonly known as "packer hides" and the bulk of the supply comes from the animals slaughtered in the big packing houses.

The material used in Army shoes is of several kinds, varying according to the service to which the shoes are to be put. So far four main classifications of Army shoes have been made, known as russet, marching, field, and trench shoes. The first three are welt shoes, and the latter, a recent design based on the experience of our army in France, is a combination welt and standard screw shoe of very heavy construction. The upper-leather used in the four types is as follows: russet and marching shoe, colored-boarded full-grain side or veal skin; field shoe, chrome retanned side leather; trench shoe, bark-tanned and heavily stuffed with grease, of heavy-weight bended stock. On account of the heavier construction, the new trench shoe costs about $6.25 a pair, as against $5 for the other types.

In contracting for Army shoes it has been the policy of the government to ask the various manufacturers of shoes to submit bids on the given specifications, naming the number of pairs which they can furnish up to a given delivery date specified by the government. In general, the contracts have been awarded, first to the lowest

First shaping cut around the edge of the sole

Putting on the heels after the soles are shaped



The final trim on the edge of the shoe-bottom

bidder up to the full amount of his bid; the next lowest bidder is then given a contract for the number of shoes he can furnish, and so on until the entire quantity has been contracted for. In some cases supplemental bids are called for to make up an additional quantity at the average price of the awards made on the first contract. Shoe men report that there have not been any large profits for the successful bidders on any of the army shoes so far.

The Army specifications provide that the vamp of the new shoe must be not less than 2½ millimeters in thickness and not more than 3 millimeters. The quarter or top has a minimum of 1⅞ millimeters and a maximum of 2½. In order to live up to these specifications, all the upper material, after being cut, has to be sorted and tested by a gage to come within the government requirements.

Furthermore, the leather is again sorted at the factory, the heavier weight hides being cut into large shoes and the lighter weight hides into smaller shoes.

The outer soles and middle soles used on Army shoes are cut from fine-haired or green salted hides of the best quality tanned with vegetable materials such as oak or hemlock bark. The thickness of these soles is rigidly specified and must be between nine and eleven iron. Any soles as much as half an iron under weight are rejected although a half iron is only $\frac{1}{64}$ of an inch. This sole leather is not only measured for thickness but is analyzed to see that it does not contain an excessive amount of weighting material, such as glucose or epsom salts.

The inner soles are extremely heavy, ranging from 6½ to 7½ iron, which is about the same weight as that used for women's outersoles. The same care is taken in selecting stock for this purpose as for the outer soles.

Heels and tops lifts are of solid leather. No shoddy or imitation leather is accepted. The government maintains an inspection service in all factories where Army shoes are being made. These inspectors look over the quality of the sole leather and heels, upper leather and the finished shoes. Each shoe is stamped with the inspector's name before being shipped from the factory.

The manufacture of shoes is one of the most intricate and complicated processes found in any industry. In making an ordinary shoe there are 174 machine operations performed upon 154 different machines, and 36 hand operations, or a total of 210 processes. The principal methods of manufacturing shoes are known as the Goodyear welt; McKay; turned; standard screw; pegged; and nailed. The better class of shoes are sewed by either the Goodyear or McKay machines. The "turned" or "turn" method is used in making fine shoes and slippers for women and children. The chief difference between the turn shoe and the welt or McKay is the absence of an insole. Only good leather of pliable quality can be used in making this kind of a shoe, as it is made wrong side out and then turned right side out.

The standard screw shoe is made by tacking the heavy outsole in place and fastening it by means of screws. The metal which forms this fastening is in the form of wire with continuous screw thread. When the screw reaches the inside of the shoe, the machine automatically cuts it off and feeds to the next fastening. This method makes a strong but stiff shoe.

In making a new model of shoe, a wooden master last is first modeled from the human foot. The ordinary last is made of wood but it has a plate of iron along the

(Concluded on page 554)

The Army shoe-fitting outfit just adopted

Surgery by Mathematical Formula

By Robert G. Skerrett

CHEMISTRY, mathematics, and the microscope are proving potent agencies in minimizing the ravages of bullet, shell, bomb, and the other baneful instrumentalities employed by the Teutons on the European battle fronts. For the medical man has had to measure forces with the insidious workings of infinitesimal micro-organisms, and these have in hundreds of thousands of cases wrought havoc out of all proportion to the original extent of the wounds. Virulent bacteria have aggravated relatively trifling hurts, and have radically altered the problem of the military surgeon. The vast majority of the soldiers who have been wounded have been found afflicted with suppurating injuries when ultimately dealt with at the base hospitals; and this state of affairs has entailed a high percentage of amputations and involved physical impairments of a more or less extensive nature. Not only that, but in the earlier period of the war suffering was dreadfully prolonged and lives sacrificed mainly because the scalpel could not deal conclusively with the micro-organisms and their poisonous effects.

Adding liquid chlorine to a soda solution—the latest method of preparing the Dakin antiseptic solution of sodium hypochlorite

Nature has given us in our bodily cuticle a natural defense against the billions of germs that lie in wait for us at well-nigh every turn. Most of us little realize it, but every break in the skin is a breach through which bacteria may penetrate our physical stronghold and possibly drive us to the wall in a feverish struggle for life. Fortunately, we dwellers of the city have become immunized in large measure to many of the micro-organisms that surround us. Not so "over there," because the bacilli that lurk upon the battle ground are those of tetanus, gas-gangrene, and certain putrefactive organisms. They are there in noxious abundance simply because of the character of the fertilizers that have been strewn upon those erstwhile productive acres to make them fruitful. No wonder, then, that infected wounds greatly predominate.

Accordingly, if he be stricken in the trenches or thereabouts, it is next to impossible to safeguard the soldier by precautionary measures against the inoculation of one or more types of these bacilli. The best that can be done to help him is to neutralize the action of the micro-organisms and, accepting their presence, to destroy them before they can gain the upper hand against the natural resistance of the body and the coöperative labors of the surgeon. This is just exactly what Doctor Alexis Carrel of the Rockefeller Institute of Medical Research initiated quite three years ago just back of the Western Front in France.

Doctor Carrel recognized shortly after he joined the French ambulance service that the surgeon's task would be a hopeless one as a rule if he could not find a way to sterilize infected wounds. The problem was not that of applying the traditional ounce of prevention but of resorting to a pound of cure that could be relied upon to do the delayed work well and thoroughly. Theoretically, this scheme of treatment was directly opposed to that advocated by the conservative members of the medical profession, who for many months after the outbreak of hostilities could not bring themselves to realize that peacetime surgery and wartime surgery differed in some profound respects.

Undeterred by the criticism of his confreres, Doctor Carrel pursued his investigations; and out of the months of patient, painstaking, and exact researches carried out by him and his associates, was evolved what is generally known as the Carrel-Dakin treatment for infected wounds. The thing sought was a germicide that would be equally fatal to all micro-organisms carried into a wound and yet which would be so mild in its operation that it would not irritate the raw surfaces of the injury. This was a pretty large order, and it is not surprising that more than 200 sterilizing fluids were tested before hypochlorite of soda was chosen. The essential problem was to free it of certain irritative alkaline ingredients.

Today, the practice at the War Demonstration Hospital in New York city, established by the Rockefeller Institute, is to use chlorine produced by an electrolytic process. This insures absolutely pure liquid chlorine and enables the chemist to control the strength of the germicide to a nicety. The liquid chlorine is passed through a solution of sodium carbonate, and in this

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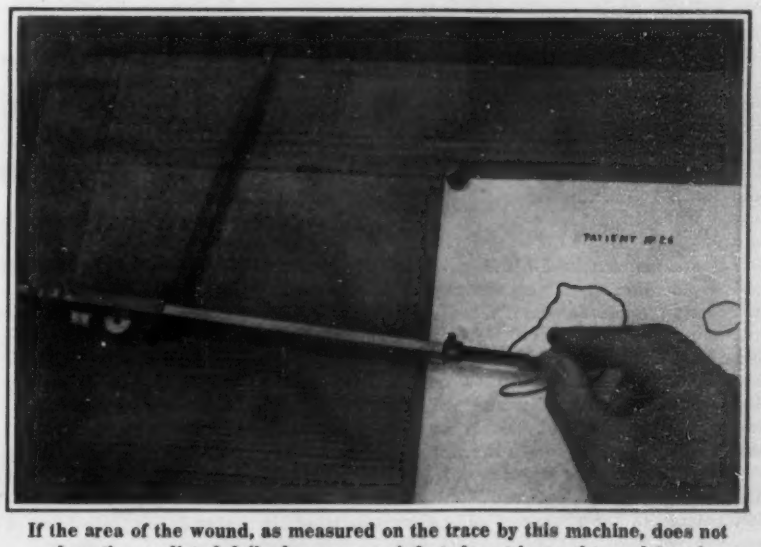
Making traces of the contour of a healing wound on a thin sheet of sterilized celluloid



If the area of the wound, as measured on the trace by this machine, does not show the predicted daily decrease, an infected spot is sought—and found

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Science and Crime

NOTWITHSTANDING the occasional cleverly planned crime committed by an educated person, the great majority of crimes may be set against those who are uneducated. They are not only ignorant of the law and unmoral, but the many aids which the law has for uncovering that which they thought to be effectually hidden are entirely unfamiliar. The fear of being detected holds many a one in the straight way and what a shock it must be to an offender when science picks up a thread and the whole fabric is brought into view.

Two men kept their horses in the same barn and each had his own feed under lock and key. The men did not get on very well and by and by one of the horses died. A, the owner, immediately hailed B into court and sued him for the value of the dead steed. But B's attorney, knowing something of chemistry and microscopy, not only had an analysis for poisons made, but caused the starch found in the dead horse's stomach to be identified.

He was then able to prove that while A owned corn, the starch found in the stomach of his dead horse was not corn starch but from oats—the feed used by B. And it also developed that B, long suspecting A of theft, had put poison in his oats which A then carefully fed to his horse. How could such a tangle have been solved positively without science? In place of a cash settlement A received a light sentence for petit larceny.

These true stories have naturally attracted the novelist who, on paper, performs wonderful feats in detecting criminals, but seldom has a more interesting actual case developed than the following.

A ranchman was robbed and murdered. The body was thrown on a pile of brush and burned and while a man was strongly suspected, there seemed to be insufficient evidence. However, he was held and examined with utmost care immediately after the crime was discovered, with the result that on one shoe there were found a few threads held by some adhesive to the sole. Also, bits of cloth were found on the edge of the smoldering fire.

Beginning at this point, the chemist found the adhesive to be blood and human blood at that. He also established the fact that the threads on the shoe and those of the cloth were of the same kind, while the photomicrographic camera was brought into service to show clearly the position of the thread on the shoe sole.

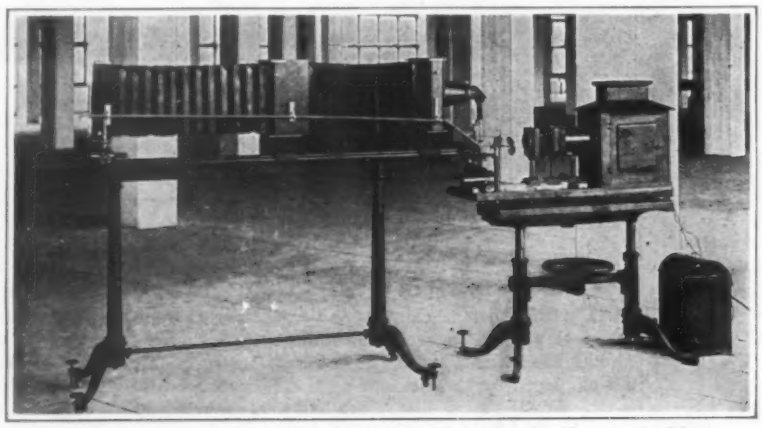
In view of this evidence a conviction was secured, and later it developed that the murderer, in his endeavor to burn all the evidence, had scraped the odd pieces into the fire with his foot, thus picking up the fatal threads.

Can you imagine the sensations which the uneducated offender experienced as the tests were described, the data submitted and the photomicrographs passed about?

For some time it has been possible to distinguish human blood from that of animals and to identify many varieties of animal blood, thus making the often used explanation of chicken killing or the like quite unavailing. There has been some difficulty, however, in securing proper samples of old, dried blood for microchemical and microscopical examination. Lately a new method has been developed based on the fact that red blood corpuscles may be transferred by a solution of celloidin in ether-alcohol. Eosin may be used as the stain either by application to the suspected blood before removing it, or after it is on the slide. A thick solution of celloidin is applied, preferably to the edge or to some thin portion of the spot, and after drying is carefully removed, carrying the blood with it. This method gives a good fixation of the blood leaving the corpuscles unchanged, thus permitting measurements, and is particularly satisfactory where blood is to be removed from non-absorbent surfaces such as rocks, metals, wood, weapons and the like. With a slight modification it is said to give good results with textiles.

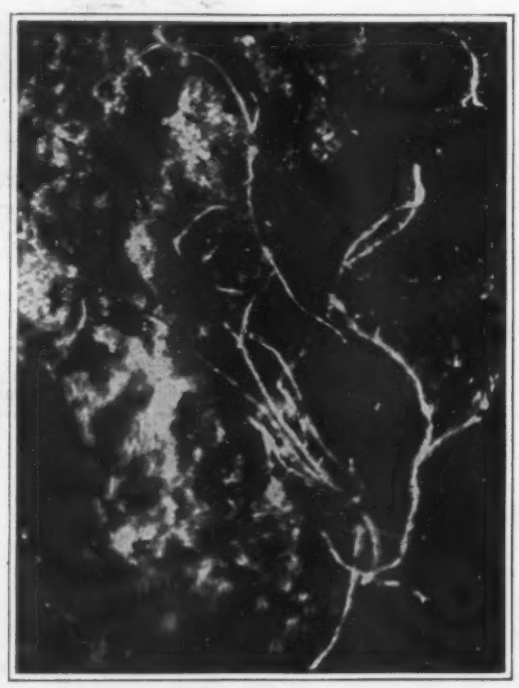
The comparison ocular whereby the images of two microscopes may be brought side by side in one field of view has been of great help in checking unknowns against standards, especially in handwriting comparisons, fibers, blood and many other substances.

And so there is more and more detail for the criminal to remember, an increasing number of things to cover or remove and a greater likelihood of his ultimate apprehension. Many sciences contribute to the work, but few have done as much as chemistry and microscopy.



One type of photomicrographic apparatus used to photograph opaque objects

(Low magnification)



(High magnification)

Microscopic views of the tell-tale threads which proved the guilt of the murderer

Potash Independence

IN 1915 the writer prepared an article styled "The German Alarm Clock," in which the ground was taken that Germany's punishment would go on long after the war passed into history because she had chosen to awaken a passive world to the advantages of certain German methods, more especially in the application of science to the resources of other countries. Because of Germany's relative poverty in raw materials, it seems evident that equal efficiency applied to resources elsewhere is certain to work to the continued disadvantage of Germany.

The clock keeps ringing and we are constantly growing more independent. Germany seems to have been counting on two indispensable products to drive an economic post-war bargain. One is synthetic—dyes; the other a natural substance—potash. The world is demonstrating its ability to make its own dyes. A single British plant covers 250 acres and the statement is made that in the United States more money is now invested in dye manufacture than in any other country. We are actually exporting dyes and all but one or two groups of important dyestuffs are now made here. The missing members are now being brought up. They have not been taught to walk yet but before long they will be able to bear their part of the burden.

But what of potash? Dr. Wheeler in a recent lecture gave some interesting data that indicated something of the sources of American potash, of German propaganda and of what is being done to break the monopoly which the Hun has had due to geological formations.

There are no natural deposits of crystalline potash salts definitely known outside northern Germany, Alsace, Galicia and Spain, although claims have been made for Abysinia, India and northern Russia. Germany mined about ten million tons annually. The beds in Alsace are from six to thirty feet deep, over seven square miles, the total being estimated at 300,000,000 tons. The pre-war American importation of potash was about 500,000 tons of potassium chloride, equivalent to 250,000 tons actual potash, of which 452,000 tons were used in agriculture. The minimum requirement, at present prices, for 1918 is estimated at 147,000 tons actual potash while our production from all sources for 1917 was 30,000 tons.

Now this shortage cannot be overcome at once and the problem is just as difficult as the dye shortage, perhaps more so; but let us see what the prospects may be. There are many sources of potash, some of which are not commercially feasible of course; others offer wonderful possibilities and a prize worthy the efforts being made to win this essential compound.

Much has been said of Searles Lake in California where there is enough potassium in combination to give us potash for 40 years if a way can be found to separate it from borax and sodium compounds. A large amount of work has been done and money spent on this problem and the effort is being continued.

The cement plants are beginning to follow the example of one California plant where 100 tons a day was being discharged in fumes and dust. It is estimated that our cement industry alone can furnish 87,000 tons potash annually.

The alunite deposits have been attractive, for by roasting this mineral sulfuric acid, pure alumina and potassium are obtained. Therefore, since all these are wanted on the Atlantic seaboard, it is possible to transport alunite from the west to points favorable for the roasting and subsequent operations.

Feldspar, which runs high in potassium compounds, has attracted many researchers and much has been accomplished. In 1915 one-tenth our normal imports was derived from Feldspar and green sand. In each case the success of the work depends on the market for the by-product, which in the case of green sand, includes building brick.

The Nebraska Lakes, with 3 to 4 per cent potash, are becoming prominent as a source of supply and Great Salt Lake may also be listed as a promising possibility. Kelp maintains its position as the most important medium for obtaining potash from sea water, although some is obtained by solar evaporation in California. The giant kelp of the Pacific supplied seven factories a year ago and these plants are scattered from the Gulf of California to Alaska. This sea weed is within the three mile limit and the supply seems to justify the term, nearly inexhaustible, for specimens have been reported 3 feet in diameter and 1,500 feet long. Kelp is an annual. There are several methods of treatment varying from dry distillation with the recovery of iodine and acetone to the crystallization of the salts from the expressed

(Concluded on page 558)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

An Unnoted Centenary

To the Editor of the SCIENTIFIC AMERICAN:

On April 28th, a hundred years ago, there occurred an event of the utmost significance. On that day President Monroe issued a proclamation telling our citizens of the "Rush-Bagot arrangement."

Our war of 1812 ended by both belligerents agreeing to the terms of the Treaty of Ghent: a treaty of "no annexations and no indemnities," signed Christmas Eve, 1814, and good today. Soon, thereafter, Monroe was advised by Adams, our Minister in London, that Britain intended putting more and more war vessels on the Great Lakes, our northern boundary. Were this done Monroe realized that this country must do the same. He, therefore, wrote to Adams that if Britain followed this European militaristic method there would be "vast expense incurred" by both countries, the "danger of collision" would be increased, and the rivalry in armaments would prove a "constant stimulus to suspicion and ill will"; and urged that both countries should "abstain altogether from an armed force beyond that used for revenue."

Britain for many months refused assent to his views. Adams, after talking to Lord Castlereagh on January 25th, 1816, wrote that Britain's acceptance of the proposal "appeared hopeless." Monroe, however, persisted. He showed that the "moral and political tendency of such a system, the old European, must be to war and not to peace." Finally, after much discussion, good sense triumphed over prejudice and precedent, and on April 28th, 1818, Monroe had the satisfaction of proclaiming to our nation the signing of the Rush-Bagot arrangement, by which the contending countries agreed to do away with all ships of war on the Great Lakes; any already thereon were to be dismantled; any in course of building, converted to other use; and only four little revenue cutters, or patrol vessels, were to be permitted for each nation on the entire river and lake system.

It is the spread of this successful American system that must rescue Europe from its present recrudescence of barbarism, now rushing civilization back to chaos. Surely the centenary of such a remarkable "arrangement" is at least worth a passing remembrance and comment!

EDWARD BERWICK.

Pacific Grove, Cal.

A Permanent Index

To the Editor of the SCIENTIFIC AMERICAN:

The SCIENTIFIC AMERICAN and the SCIENTIFIC AMERICAN SUPPLEMENT are probably more universally taken by libraries in this country than any other single periodical of a technical nature, and are considerably used for reference purposes. The number of volumes has now become so great, however, that it is extremely difficult to carry a search through the file, and this difficulty is increased by the lack of any adequate indexes. I am sure that a collected index to the two periodicals would be of great value to all owners of a file of the magazine, and I would like to suggest that you consider the desirability of publishing such an index in the near future.

In my opinion an index of this character is particularly desirable in cases of such publications as your own, as it would answer not only the purpose of calling attention to the extraordinary amount of information contained in their pages, but would also act as a key, through your journals, to the original material from which the SCIENTIFIC AMERICAN summaries have been prepared.

HARRISON W. CRAVER.

Engineering Societies Library.
New York.

[*The high compliment paid the two* SCIENTIFIC AMERICAN *publications is appreciated, and it is believed to be in large measure deserved. These journals existed before there was adequate technical literature in the modern sense of the term, and the scores of volumes cover the growth of our country as do no other periodicals.*

It is therefore true that an index of the kind mentioned by Mr. Craver would be an extraordinary convenience. It would, however, be of value only where an entire set of the bound volumes for the period covered by an index volume was available. Assuming twenty years as an arbitrary figure, it appears that only the largest and more permanently established of libraries would fall within the class of prospective users; while the number of private individuals who bind periodicals is not now large—more's the pity. This automatically limits the circulation of Mr. Craver's suggested index to a very small circle; and under the existing conditions, the expense of compilation and composition would make the undertaking quite out of the question. Accordingly we can only thank Mr. Craver for his suggestion and express the hope that the time may come when it will be possible of realization.—THE EDITOR.]

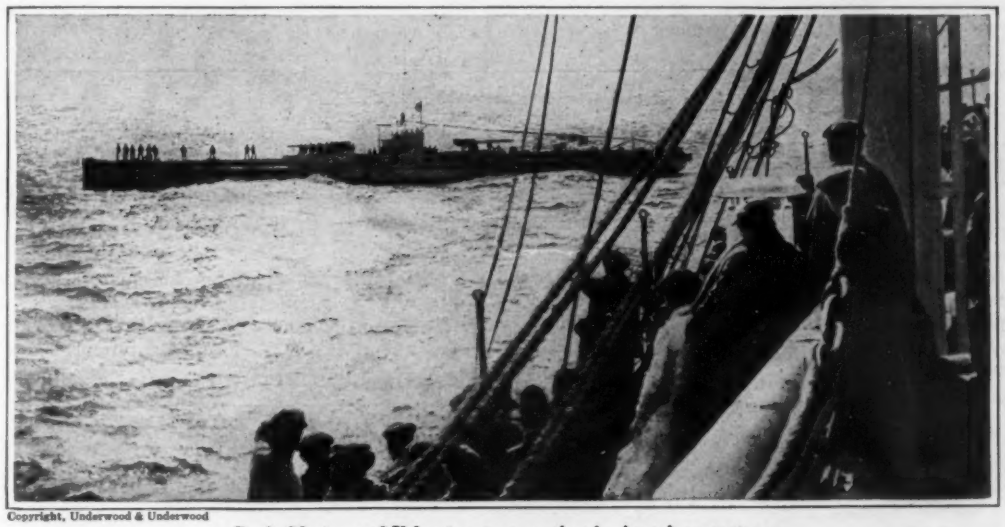
A Filament Phenomenon

To the Editor of the SCIENTIFIC AMERICAN:

Some time ago a note in your columns mentioned the blackening to mirror-like perfection of an incandescent lamp in an automobile. The following is actual experience of this writer:

An ordinary 50-watt tungsten lamp of the long filament type had the filament broken. Examination led to belief the filament might be reunited, as have frequently seen done, although there was the possibility that in tapping it back into place it was liable to attach at another point that would much shorten the circuit. Several minutes were spent in turning and tapping the lamp, in circuit, when suddenly there was a blinding flash, much stronger than the ordinary illumination. Immediately the bulb was noticed to be opaque. Upon breaking the globe, the inside was found to be heavily coated with a layer of substance very much like very white ashes. There was no sign of any part of the filament, but all the supports were intact.

Muskogee, Okla. M. R. MOORE.



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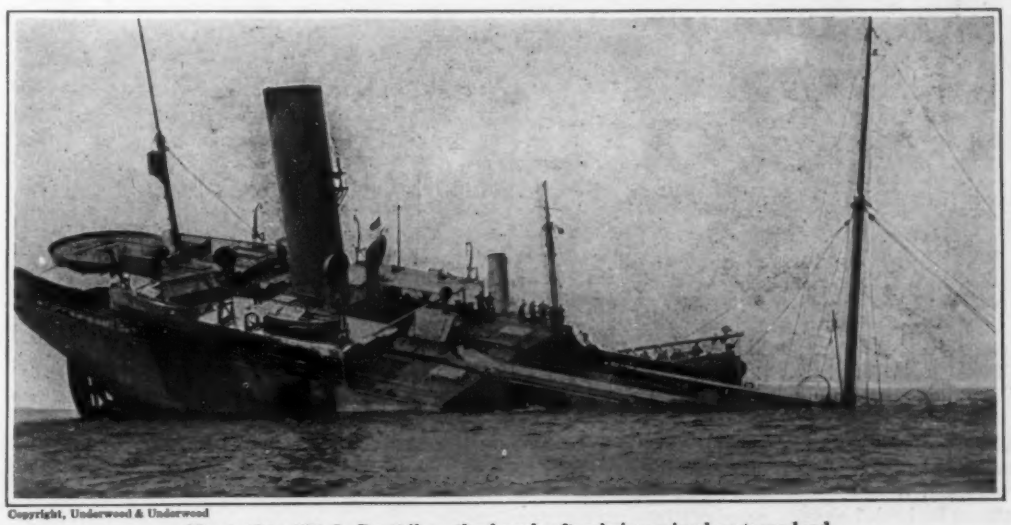
Probable type of U-boat now operating in American waters



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The tanker "H. L. Pratt," on the beach after being mined or torpedoed

Germany Brings the War to Our Coasts

IT is too early as yet to estimate the recent submarine attack on United States ships in United States waters at its true value. It may be the opening phase of a really serious submarine campaign against the transports which are carrying our troops to Europe, or it may be merely another of those curious and utterly futile attempts of the Hun to break down the morale of the civilians of Allied countries.

The sending of one, two, three or more submarines across the Atlantic for a raid upon our coasts has long been recognized by our naval men as perfectly possible; but it has been expected that the appearance of enemy U-boats would be sporadic and devoid of any marked military result.

For we must remember that U-boats are scarce and growing scarcer, and that it is imperative to employ such as there are where they can do the most damage; and they can do the most damage where the quarry is most plentiful; and the quarry is most plentiful in the English Channel, in the Irish Sea and in the approaches to the French ports. That is the neck of a bottle which represents all the seven seas, and a submarine pirate operating in those waters has ten times as many opportunities to sight an enemy ship as he would have while wandering up and down the two thousand miles of our Atlantic seacoasts.

The question of whether Germany sends over more submarines depends upon another question, namely, whether we arm our ships and put them in shape to fight back. The U-boat captain is a sneak fighter and he never comes any closer to real danger than he can possibly help. He has profound respect for a 6-inch gun showing its lean snout over the taffrail of an American merchant or passenger ship. So, if we wish to discourage the advent of other submarines, we should do at once what we ought to have done many, many months ago, namely, mount a 5- or 6-inch gun at each end of our larger passenger and freight ships, and at least a 6- or 12-pounder on our schooners and smaller trading craft.

As to the size of these submarines it is safe to say that they are not nearly as large as reports of passengers and crews of vessels attacked would seem to indicate. Probably a length of 250 feet would be a fairly close guess. A ship of this size could easily cross the Atlantic, carrying enough fuel and supplies for raiding operations on this side of the ocean, lasting for several days.

The accompanying illustration, taken from the Spanish liner, "Infanta Isabel," which shows the submarine that has just caused her to heave to, agrees rather closely with the description of the submarines on our coasts furnished by crews of vessels that have been sunk. It will be noted that this U-boat when at the surface looks remarkably like an ordinary low-lying surface craft which has been denuded of masts and deck structures. The two guns appear to be too large for 4-inch, and probably are of the German 5.9-inch standard caliber.

What Your Fifty-Dollar Liberty Bond Will Do In the Medical Line

IT will protect 1,000 soldiers from small-pox and 666 from typhoid. It will assure the safety of 139 wounded soldiers from lockjaw, the germs of which swarm in Belgian soil.

It will render painless 400 operations, supply two miles of bandages—enough to bandage 555 wounds.

It will care for 160 injuries in the way of "first-aid" packets.

It will furnish adhesive plaster and surgical gauze enough to benefit thousands of wounded soldiers.

Every purchaser of a Liberty Loan bond performs a distinct individual service to his country and to our boys fighting in France.

Italian Industry in the War

The Manufacture of Artillery by the Ansaldos, the Genoese Krupps

By Arthur Benington

WHEN the Royal Italian Mission was in America a year ago, one of its principal members made the remark that what Italy had been able to do in a military way against Austria was due to two men more than to anytning else, and that these two men were the Commendatori Pio and Mario Perrone, principal directors and stockholders of Giovanni Ansaldo & Co. of Genoa, who had kept the army and navy supplied with a constant stream of guns and ammunition of all sizes.

And General Dallolio, Italian Minister of Munitions, made a statement in December that the munitions factories of Italy had within one month after the terrible disaster at Caporetto made up the entire loss of guns and ammunition that followed that defeat. The Italian War Office has never told how many guns were lost there, but the Germans and Austrians claimed to have taken half the total supply of the Italian army. Their claim was probably exaggerated, but it is safe to say that more than a thousand cannon fell into their hands, and vast stores of ammunition. The chief labor of replenishing this depleted armament fell upon the Ansaldo company, whose factories at Genoa hummed as they had never hummed before with the rush of work. Day and night their furnaces roared and their hammers clanged, as shift followed shift of skilled mechanics. And their proving grounds banged incessantly like a section of the battle line as battery after battery of naval cannon, mortars, field pieces, bomb-throwers and siege guns was placed in position and tested before being rushed to the front.

Firing a 76-millimeter anti-aircraft gun

The photographs on these pages were taken in the Ansaldo works; they might be multiplied a hundred times and scarcely give an adequate idea of the tremendous output of guns of all sizes that is ever pouring from the company's workshops. A beautiful and impressive contrast is that between the 381-millimeter cannon and the little trench mortar that can be carried in one man's hands—the Goliath and the David of artillery. The former is the largest gun turned out by the company; it throws a shell approximately fifteen inches in diameter and has hitherto been used exclusively on battleships; but this war has brought large caliber artillery right into the field in all armies, and the 381-millimeter gun is now used by the Italians on land as well as on sea. An excellent idea of its size can be had from the photograph that shows three of them unmounted in one of the factories, with a man standing between them.

This gun is so heavy that it cannot be hauled about like an ordinary field gun, even with the powerful tractors that are now being used for this purpose. Its weight if on a carriage would ruin the best of roads and might easily result in breaking through them and getting the gun itself stuck. But it can be run about on railroads without danger if mounted on trucks that will bear its weight. One of the most interesting of the photographs on this page is that of the railway trucks designed and built by the Ansaldo company especially for this gun. It would be more interesting still if the gun were shown on its mounting. There are three trucks, arranged in such a way that the central one, with 10 wheels, carries most of the weight, but transmits it at either end to the smaller trucks, each of which has 12 wheels. This arrangement makes it easy for the gun to be hauled along railroad tracks even with sharp curves. It is a most ingenious device, extremely simple but perfectly effective. It makes it possible to bring this gun up as near to the enemy's line as a railroad can safely be built and to haul it away quickly to security in case of a serious retreat. This impressive triple-truck gun carriage is the invention of the company's engineers. Without it, these 15-inch cannon could be used only on warships.

A battery of 260-millimeter mortars in one of the forts near Genoa

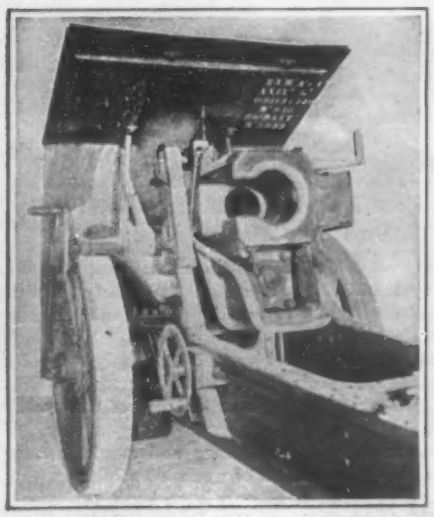
The heaviest mortars built by the company are the 260-millimeter, of which a battery is pictured in one of the most striking of the photographs, and of which a single specimen is shown on its carriage in the position in which it is moved from one point to another. It will be observed that the ponderous barrel of the mortar, with a part of its mount, slides backward and downward upon the main part of the carriage, thus occupying little space and making transport easy. Within a few moments and by the turning of a few cranks the giant gun is pushed forward into its position for firing. Thus a mortar that fires a shell almost 10¼ inches in diameter becomes a mobile gun that can be rushed from one part of the front to another.

Little less impressive are the 210-millimeter mortars on their caterpillar-wheeled carriages. These throw a heavy shell a short distance by means of a large charge of quick-burning powder. If great length of range were desired it would be necessary to lengthen the barrel of the gun so that slow firing powder, exerting an ever-increasing pressure while the projectile is passing out, could be used.

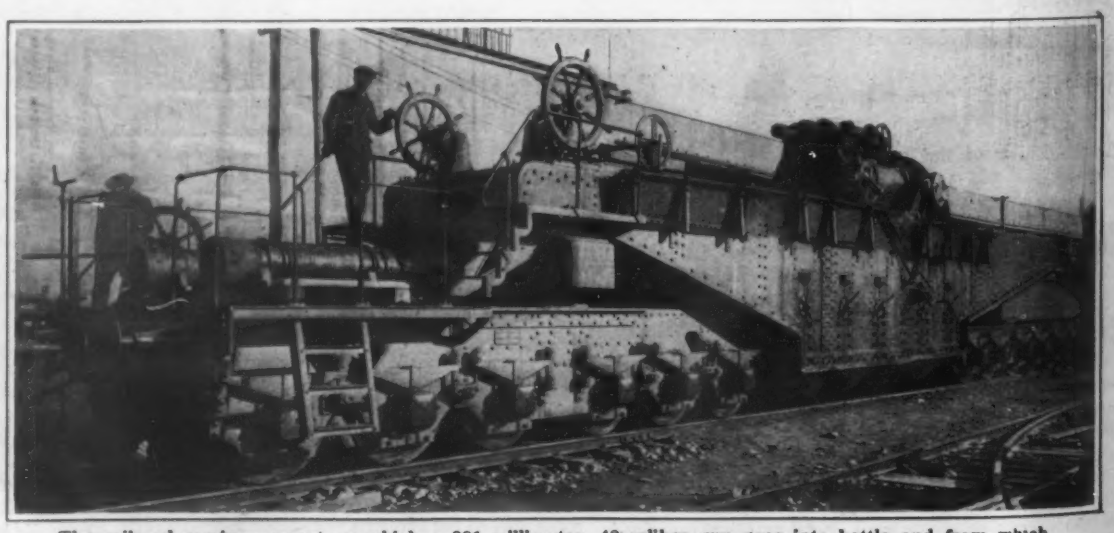
Leaving the very heavy guns which are being employed as field pieces for the first time in this war, we come to the usual field pieces, employed in such enormous numbers by all the armies. Photographs are shown of the Ansaldo company's 102-, 149- and 152-millimeter guns in several typical positions. The lighter of these, which fire a shell of about four inches in diameter, are among the most simple in construction of all guns. They are mounted in several ways, but the specially favored mount in the Italian army is the automobile. These auto-batteries make use of no horses; the guns themselves are on automobile carriages with seats for two gunners, and the gun crews accompany them in motor-camions and on motor-cycles. The result is the acme of mobility. Two of the photographs show these guns, one on the march, the other in position for firing, while a third shows a rear view of one of the same guns on an ordinary carriage with its breech open for loading. The shell having been placed, one turn of the handle to the right drives a heavy slide over the breech and the gun is fired. Another simple turn opens the breech again ready for reloading.

There is little difference between these and the 152-millimeter guns: they have the same general plan of using the recoil for dropping the barrel back into position for loading and of almost telescoping the gun on its carriage when necessary to move it.

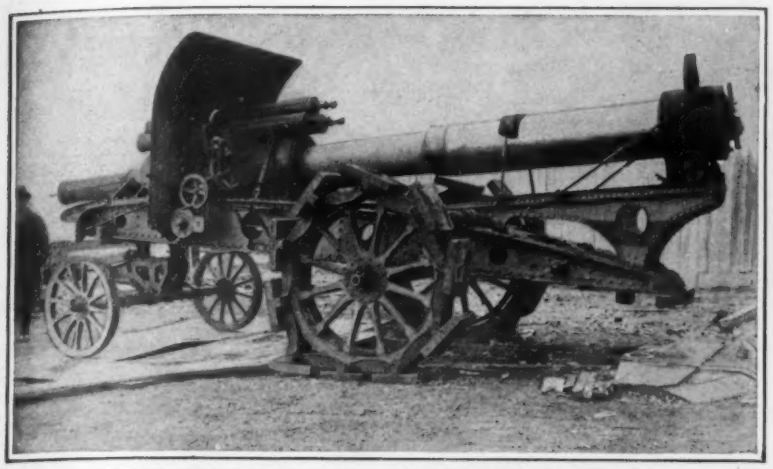
The anti-aircraft guns are an entirely different type. Mobility is not always their essential, for they are in-



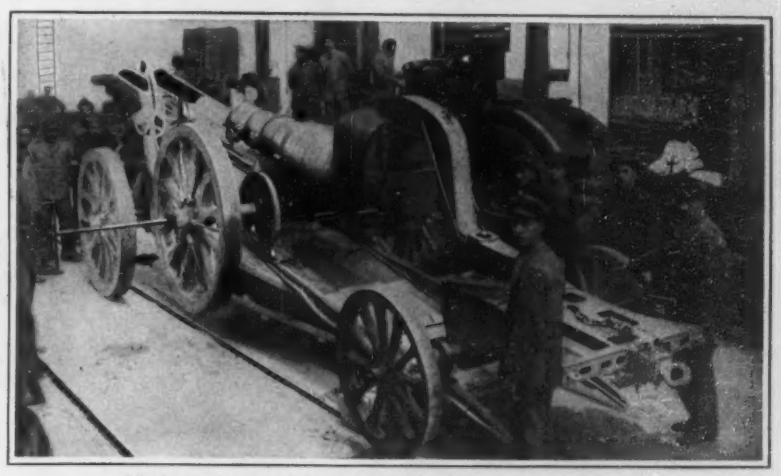
The breech of a 149-millimeter field piece



The railroad carriage mount on which a 381-millimeter, 40-caliber gun goes into battle and from which its fire is directed upon the enemy



A 152-millimeter gun on its carriage in position for transport



Method of mounting a 260-millimeter gun for transport

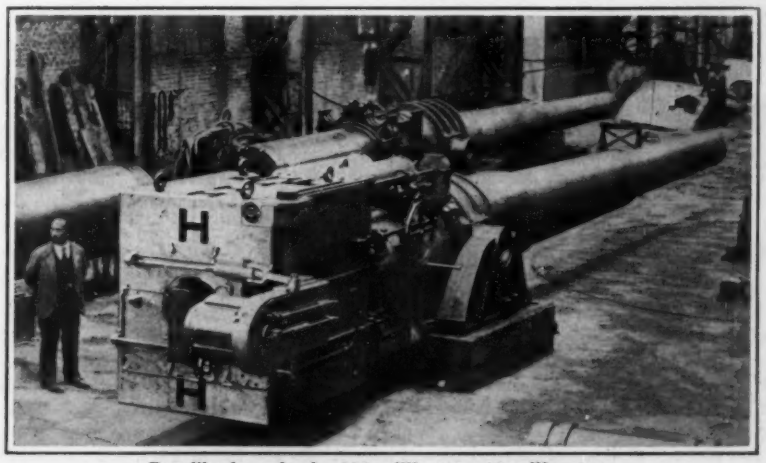
tended principally to defend cities against raids from the air and are permanently stationed. The greater the distance an anti-aircraft gun can fire the better. Therefore they are of the long-barrelled type, most of them being 45 calibers long, on stationary turret-like stands, on which they can be turned in all directions. Their barrels slip back with the recoil and are thrown forward again before firing.

In comparison with these monsters the trench bomb-throwers seem like playthings. They can be carried by one man without much difficulty, and are really nothing but tiny mortars, intended to throw bombs a few hundred feet. This form of warfare is a novelty of this campaign. It grew out of the throwing of hand grenades, long supposed to have been obsolete, but brought into vogue again by trench warfare.

The Ansaldo company's shops where these cannon are forged seem to the rare and highly privileged visitor like the antechamber of the front line trenches. A hundred feet overhead pass silently the electrically drawn wagons of the aerial railroad bearing their loads of metal. Two hundred feet overhead the arms of the cranes reach out and seize the material. Armor plates or rough-forged tubes for cannon swing aloft, held by the powerful magnets that serve instead of grappling hooks at the end of the chains. Furnaces with blasts of air entering at 800 degrees Centigrade and heated to 1,500 degrees devour raw materials and pour forth rivers of liquid steel, sputtering sparks, into the molds that form the ingots. These furnaces pour forth steel that is cast into 150-ton ingots for armor plate, barrels of cannon and small arms.

In a vast building, more than 2,000 feet long and nearly 1,000 feet wide, are cannon returned from the front to be repaired, for

The tiny bomb-throwing mortars used in the trenches by the Italian army, completed and in course of manufacture



Box-like breech of a 381-millimeter, 40-caliber gun

the terrific heat and pressure of their powder gases soon wear out the inner tubes especially of the greatest of these guns. By the Ansaldo company's own process, the inner tubes of these cannon are chilled and made to contract while the outer part is heated and made to expand. The inner tube is then drawn out and a new inner tube, this also contracted by cold, is inserted into the heated and expanded jacket. After some hours the jacket cools and contracts while the inner tube grows warmer and expands, thus making a fit so tight that the inner tube is irremovable except by a repetition of this process.

For every one of these guns, large and small, the Ansaldo company makes the shells and cartridges. When it delivers a battery of cannon to the army it sends it complete, ready to go into action, its guns mounted and thoroughly proven, its ammunition wagons laden with a sufficient quantity of well tested shells. The many factories in which these shells are made are filled with the latest machinery for turning, boring and forging metal. Thousands of women and girls are employed at the lathes, on the grinding and polishing machines, and in the exquisitely accurate work of calibration.

The historic words of Victor Emmanuel, "Italia fara' da Se," have never had a better exemplification than in this work that the Ansaldo company has accomplished since Italy went into the war. In the beginning it seemed an almost superhuman task; but the Italian engineers had the imagination and the courage to undertake it, and they are entitled to all the credit that the generals and ministers of their country so freely give them for their stupendous contribution to winning the war.

An automobile battery of 102-millimeter guns on a mountain road at the Italian front

A 76-millimeter, 17-caliber, anti-aircraft gun

Specimen of the seed type of sugar-beet

Sugar-beet seed cut and piled in rows

Seed stems covered with paper bags after trimming

Making America Self-Supporting

Breaking Germany's Monopoly on Sugar-Beet Seed

By Truman G. Palmer, Executive Secretary, U. S. Sugar Manufacturers' Association

MUCH has been written about the dependence of the United States upon Germany for many of the essential raw products used in manufacture. Instances are indeed not lacking where great manufacturing industries are more or less dependent upon foreign countries for some portion of their raw material; but that an industry established and operating in all the great temperate-zone nations of the world, and supplying the world with one-half of its pre-war sugar requirements, should be almost entirely dependent upon less than a dozen wealthy men in Saxony, is a fact as remarkable as it is deplorable.

Prior to the outbreak of war in Europe, the world produced approximately twenty million tons of sugar annually, about one-half of this being derived from sugar beets and the other half from sugar cane. While the sugar produced from these two plants is identical, there is a vast difference in the methods of propagation of the plants. The sugar cane of the tropics springs from the same root year after year and comparatively little cultivation is necessary to produce a crop. In order to grow a crop of sugar beets, on the other hand, it is necessary to plant the seed each year, and the plants must be intensively cultivated throughout the growing season. Again, the wild beet is low in sugar content, and it is only after many decades of patient scientific work that a sufficient amount of sugar has been bred into it to make it a profitable crop. Inasmuch as the tendency of the plant is to revert to its original state of low sugar content, the work of the plant breeders is never ending, and sugar companies naturally purchase their seed from breeders of the highest established reputation. It so happens that the leading sugar-beet seed growers of the world are located in Saxony; this one province supplied nearly 70 per cent of the seed from which the world, in 1913-14, produced 9,784,000 tons of beet sugar, or one-half its total sugar production. In fact, 90 per cent of the world's beet-sugar crop in the year mentioned was produced from seed grown in Germany and by German firms which controlled the large production of Russia.

Bearing the above facts in mind, one readily can appreciate the position of the American beet-sugar industry at the outbreak of war in Europe. The American beet-sugar factories were importing about ninety-one per cent of their annual seed requirements from Germany and Austria, while every other country from which we imported seed was either directly involved in the war, or indirectly affected by it. But upon the outbreak of war, conditions surrounding the importation of seed were entirely disrupted and the situation was the cause of grave concern to American producers. It was a particularly unfortunate time to be cut off from the usual supply, as seed stocks in the United States had never been so low. The average New York wholesale price of granulated sugar for 1913 had dropped to 4.278 cents per pound, the lowest in history, and Congress had provided that the import duty on foreign sugar should be abolished on May 1st, 1916, which would still further lower the price of the product. Discouraged by the gloomy outlook, company managements had allowed their seed stocks to decline and when war was declared in 1914 and the price of sugar began to recover, some beet-sugar companies did not have a bag of seed on hand for their 1915 planting, others had but a small supply, and only a few were well provided for.

After the outbreak of war, the German and Austrian seed growers demanded payment in Rotterdam, upon delivery of railroad bills of lading. In the fall of 1914, the financial and industrial conditions were in such a chaotic state that it was found necessary to send a committee of beet-sugar manufacturers to Rotterdam, not only to arrange for payment at that port, but also to facilitate seed shipment. During their stay of practically two months the committee finally succeeded in shipping between nine and ten million pounds of beet seed.

In 1915, a survey showed that the quantity of German seed desired for 1916 planting in the United States amounted to from 14,000,000 to 16,000,000 pounds. British blockade and German embargo had broken off business intercourse between the United States and Germany, except through diplomatic channels. In negotiating for the importation of seed it was accordingly necessary to conduct all correspondence by cable through the Department of State. This correspondence brought an ultimatum from the German Government that the exportation of sugar-beet seed to the United States would be allowed only upon the condition that we first land foodstuffs or cotton at a German port, to the value of the seed to be exported. But Great Britain had blockaded German ports and would not recede from her position. After several months, during which time scores of cablegrams passed between Washington and Berlin, permit to export a meagre 1,650,000 pounds was secured from Germany, "as a special consideration to the United States." Germany, however, reserved the right to designate the companies from whom the seed should be purchased and these in turn designated the American companies to whom it should be allotted.

But the difficulties did not end here. After securing permission of the German Government to purchase 15,000 bags of seed in that country, it then was necessary to get British consent to ship the seed from Rotterdam. This required many weeks of diplomatic correspondence between the United States and British Governments. While this was going on, and several weeks after the German export permit had been granted, the State Department was informed that unless the money in payment for the seed was actually in Germany on a certain date, and the seed actually exported beyond the borders of that country, the permit would be revoked. The time limit set was so short that it was physically impossible for all the American beet-sugar producers to complete the financial arrangements, so one of the larger companies stepped into the breach and guaranteed the entire amount, which was immediately cabled to Germany by the express company. Due to this action, the

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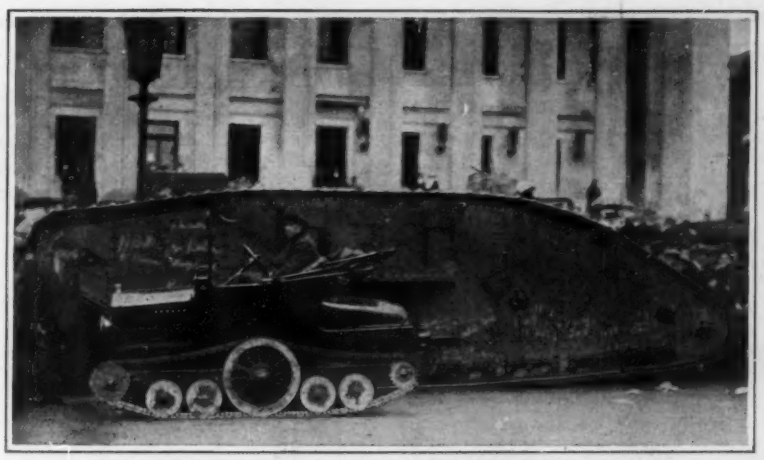
Shocks and standing plants of sugar-beet seed

Cutting and tying the shocks of sugar-beet seed

The Two-Man Tank

THE large British tank which is being taken over the country by the British-Canadian Army to create interest and do its bit toward getting recruits, was left standing on the street in Springfield, Mass., while the officers in charge went to lunch. When they returned they found that the tank—known as "Miss Brittania"—had a little colt toddling by its side. The colt was vigorous and frisky and very imitative.

The colt turned out to be the experimental "two-man tank," thus brought into public view for the first time, with the idea of comparing its performance with that of its big English mother and to see whether there was anything in the big one to offer a suggestion whereby the baby tank could be improved. The inventor is satisfied that the small machine will go anywhere the big one will go and many places where the big one won't go, and that it is much faster. The one exhibited had the ordinary runabout body, so the method of armoring was not disclosed. The inventor hopes to have his machine adopted by the army for the regular use at the front.



Mother and daughter—a British tank and its American offspring

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Retaining shaft at the right and buoyant safe at the left, used in the trial

Floating Safes for Use Aboard Steamers

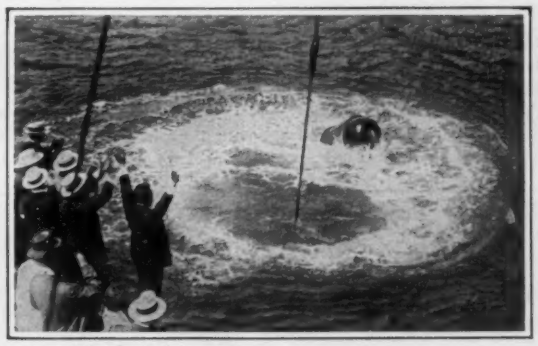
THE other day the floating safe of Menotti Nanni of Chicago, Ill., was given an official trial. And it came through successfully, thereby fulfilling the predictions of the inventor and proving to everyone that it is now possible to safeguard mail and treasure aboard steamers, even in these days of lurking U-boats.

Briefly, Mr. Nanni's floating safe is a short cylinder with rounded ends, as shown in one of the illustrations. The cylinder contains suitable buoyancy members, as well as a revolving arrangement of partitions so that any one of the radially arranged compartments may be brought in line with the single door, thus permitting mail, jewelry, money or other valuables to be deposited for safe keeping.

A number of these floating safes are placed one above the other in a long tube or shaft extending down through several decks of the steamer. At each deck a door is provided, so as to give access to the safe opposite that deck. In this manner any safe can be reached with the same convenience as the conventional safe, and by turning the inner arrangement any compartment can be brought in line with the door. The tube has really two skins; the outer one, which is intact but for the exception of the doors at each deck, and an inner or perforated skin. The object of this double skin arrangement is at once evident: it permits water to pour down through the tube to the very bottom of the shaft, so as to give the proper buoyancy to the safes. The top of the shaft, extending through the upper deck, is provided with a buoyant removable cover which, in turn, has a suitable inlet for water.

Should the vessel be sunk, water would enter through the inlet in the buoyant removable cover of the shaft, and pour down between the skins and through the perforated inner wall to the safes. Soon the safes have sufficient buoyancy, and press up through the shaft and out at the top, thence making their way to the surface where they can be picked up.

Mr. Nanni suggests the employment of a buoy at the bottom of the shaft, connected to a cable wound on a reel. As the last buoyant safe leaves the shaft the buoy comes through, pulling the cable after it. This buoy not only serves to give greater buoyancy to the safes while they are in the submerged tube, but it marks the location of the sunken vessel for the benefit of anyone who wishes to undertake salvage work.



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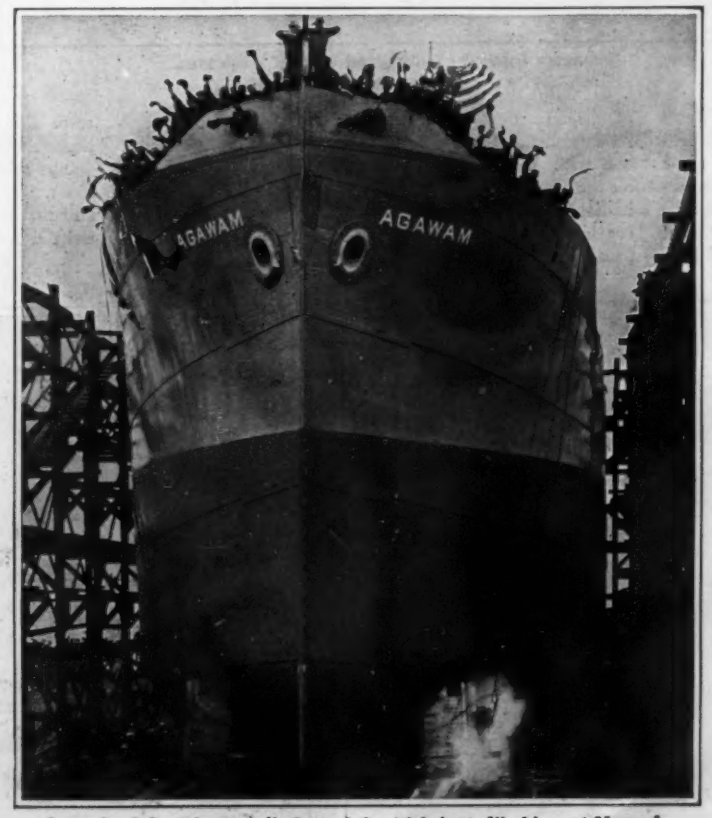
Buoyant safe coming to the surface after freeing itself from the shaft

German 15-inch Shell Thrown into Nancy

AFTER the disastrous defeat of a great German army in its attack on Nancy in 1914, the Germans were pushed back, and ultimately dug in permanently at a distance of several miles from this city. In accordance with their policy of attacking the civilian population as well as the armies of the enemy, they have emplaced batteries of heavy guns behind their own lines, and have engaged in a desultory bombardment of such French cities as they were able to reach. A most conspicuous and outrageous instance of this is the bombardment of Rheims, which, with its glorious cathedral, is now utterly wrecked. The important city of Nancy has been under bombardment, not so fiercely as Rheims, but nevertheless with very damaging effects.

Our illustration shows a 15-inch shell which was fired from a long-range gun, but failed to explode. The threaded portion at the base of the ogival head proves that the shell was fitted with a false head or windshield, which was screwed in place. This, of course, was broken off when the shell struck. An interesting technical detail is the existence of three separate rifling bands at the base: the first, a narrow band; and the other two, more nearly approximating the normal size. There is no copper band near the head of the shell, as is the case with the shells that are falling in Paris; the centering of the forward part of the shell being secured by an enlargement of its diameter at the base of the nose. It will be noticed that this section of the shell was slightly scored by the rifling of the gun as the shell passed down the bore. Since "duds" are comparatively rare with modern guns, this particular example of slacker shell is of peculiar interest.

Unexploded 15" shell, thrown by the Germans into Nancy



Launch of the "Agawam", first of the "fabricated" ships, at Newark Bay Shipyard

Launch of the First Fabricated Ship

IN the autumn of last year we presented plans of the great shipbuilding yard, which was then under construction at Newark Bay, New York, for the Submarine Boat Corporation. This firm is the same that built the 550 standardized submarine chasers which have done excellent work in European waters.

The yard is equipped with 28 shipbuilding ways and with a wharf of sufficient capacity to accommodate the ships after they are launched and during the period of outfitting with engines, boilers, etc. At the present writing, the keels have been laid for 28 5,500-ton steel fabricated ships, which are in various stages of completion. The first of these was laid early in December, and the ship was launched on June 1st in the presence of Charles M. Schwab, Director-General of the Emergency Fleet Corporation, and Henry A. Carse and H. R. Sutphen, respectively the President and Vice-President of the Submarine Boat Corporation. The "Agawam," as she is called, is the first of 150 vessels of exactly the same size and type which this company is building for the Emergency Fleet Corporation of the United States Shipping Board. She will have a displacement, approximately, of 7,800 tons when fully loaded and a dead weight capacity of about 5,500 tons. She measures 343 feet on deck, and is 46 feet broad and 28 feet, 6 inches deep. The estimated maintained speed of the vessel at sea, on a mean draft of approximately 23 feet, will be 10½ knots. The ship will be driven by a Westinghouse steam turbine running at 3,600 revolutions per minute, which will drive a single screw propeller at 90 revolutions per minute through a Westinghouse reduction gear. Steam will be furnished by two Babcock and Wilcox water tube boilers, which, by the way, were installed in the

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The Motor-Driven Commercial Vehicle

Conducted by VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Hauling Ore Over the Continental Divide

HIGH prices for metals due to the war have caused the reopening of many neglected or unprofitable mines and produced a general demand for more sufficient transportation in this industry. Hundreds of mines are known to contain ore in quantity and grade sufficient to pay big profits if the cost of moving the ore to the smelter can be kept low enough. Some mines have been closed because of failure in this respect, while others—always producing profitably—have increased their output and lowered their overhead by installing the proper hauling equipment. Hauling costs must be low for a low grade of ore. And the hauling equipment must be of the highest character to insure a low cost under severe operating conditions.

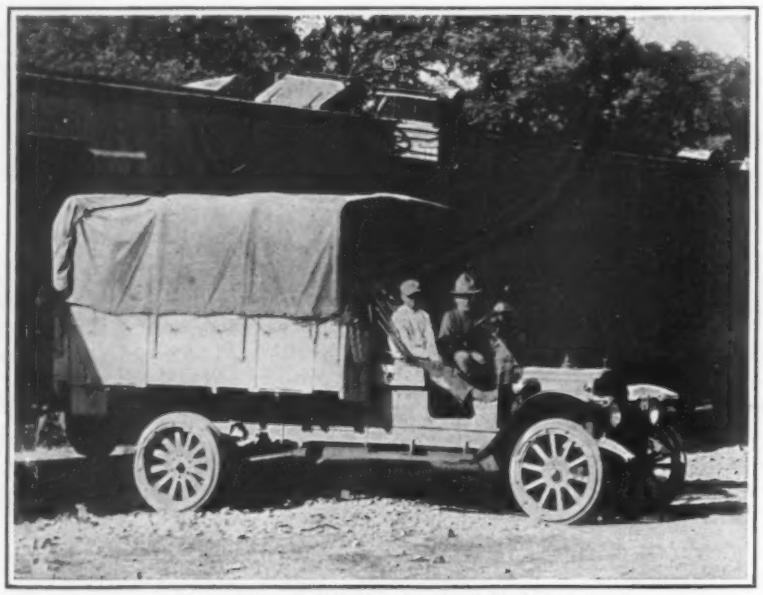
Truck with wide steel tires, hauling ore over the Continental Divide

The necessity of selecting the proper type of motor truck for the specific hauling conditions that will be encountered, is very important, mining experts agree. The conditions of service vary so greatly in different sections of the country that each installation requires a special study. This is made apparent by a few facts concerning a development company at Anaconda, Mont., whose truck with wide faced steel wheels hauls ore from the mine to the railroad, a distance of 16 miles across the Continental Divide.

The mine is 2,600 feet below the level of the railroad dumping platform. The road rises and drops over one mountain after another, finally topping the Divide at 7,300 feet elevation. The truck is operated continuously in three eight-hour shifts, making one round trip of 32 miles every six hours and leaving two hours for loading, dumping, greasing and other terminal work. The company reports that no difficulty has been experienced in climbing a 10 per cent grade on second speed with a full capacity load. Even in midsummer when the temperature reaches 100 degrees, the cooling system of the truck operates perfectly. Two trailers are frequently attached to the truck, increasing the load to 15 tons. Occasionally the outfit is used to haul supplies from the railroad to the mine, a class of work which was formerly done by horses at a cost of 75 cents per hundredweight.

Special Army Trucks for Hauling Fresh Meat

THE sanitary manner in which large quantities of fresh meats are hauled in many of the various military training camps, by fleets of specially designed motor trucks, is attracting considerable attention. In most of the camps where these trucks are used the meats are hauled from the refrigerating cars on the railroad sidings to the large cold storage plants where they are kept in perfect condition until they are ready for distribution to the hundreds of barrack kitchens. The chief purpose of the new truck bodies is to protect the meats from the dust, dirt, germs and exposure to the weather. This is accomplished by means of special metal linings and heavy waterproof tarpaulins which cover the bodies and keep out practically all light and air. At Camp Funston and Fort Riley, Kan., a fleet of special army trucks has been equipped with special racks and hooks capable of carrying 75 sides of beef on one trip. At Camp Sheridan, near Montgomery, Ala., all the meat used in the camp is carried in trucks having bodies made of metal and entirely enclosed with the exception of a large door in the rear which expedites the loading and unloading.



Army truck specially fitted to haul fresh meat

Military authorities estimate that an army of 50,000 men at Camp Funston consume the following quantities of meats every 30 days: 1,500,000 pounds of fresh beef; 270,000 pounds of bacon; 125,000 pounds of fresh mutton; 22,000 pounds of lard, 250,000 cans of meat—all of which is hauled by the motor trucks. Frequently when the refrigerating cars fail to arrive in time the trucks make hurried trips to Manhattan, Junction City, Topeka and other cities ten to sixty miles distant for the purpose of replenishing the supply. The roads are very dusty but the meats arrive in excellent condition. Camp Funston has its own refrigerating plant which has a capacity of 600 tons of ice daily. This was built at a cost of $2,000,000 and is modern in every respect. All of the materials used in the construction were hauled by a fleet of over one hundred trucks. The machinery for making the ice was also hauled.

Collecting Rubbish by Motor Trucks

A FLEET of five-ton motor trucks has supplanted horses and wagons in the house-to-house collection of ashes, waste paper and rubbish in Philadelphia. The service has been perfected to such an extent that now housewives know almost the exact hour the collections will be made. Furthermore, this regularity of collections is guaranteed throughout the year by the owners of the trucks who have furnished a bond for $70,000 with the city as a security for their contract in which they agree to pay a penalty of $1 per day, per house for failure to comply with a definite schedule. Philadelphia spends $1,000,000 a year for the collection of ashes and waste paper and city officials who are familiar with the speed, economy and dependability of the trucks, say they believe that this amount can be greatly pruned if all work is handled by trucks instead of horses and wagons. The city does not own its own equipment for this work, but prefers to split the million dollar appropriation into separate contracts and award them to large hauling companies and private contractors who own both truck and animal equipment.

A comparison of the two methods of transportation shows that one truck can do the work of at least twelve teams and wagons. This statement applies only to one section of the city, four blocks wide and two and one-half miles long, where a fleet of 12 five-ton trucks replaced 70 teams and were able to do three times the amount of work in a given period of time.

The successful performance of the trucks in this work has attracted the attention of municipalities, engineers and private contractors all over the country who have written requesting information. It is interesting to note

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Five-ton truck with special body facilities for collecting rubbish. The truck is manned by a crew of three men

A New Way Smith Form-a-Trucks are Cutting Costs and Conserving Labor

Here is a story that will interest every business man.

It is an actual experience that points the way to a solution of labor difficulties for thousands of businesses.

It is the faithful statement of fact as to how the Standard Lumber Company, headquarters in Live Oak, Florida, met and solved its twin problem of rising labor cost and shrinking labor supply.

The former method of getting lumber to its yards required two men to each lumber "dolly" or carriage.

Each man received $1.50 per day.

It was the growing shortage of labor that turned the attention of this company to Smith Form-a-Trucks. Four were installed.

Careful records were kept. They show that one man, with a Smith Form-a-Truck handles three loads at a time with far more rapidity than ten men with "dollies" did formerly.

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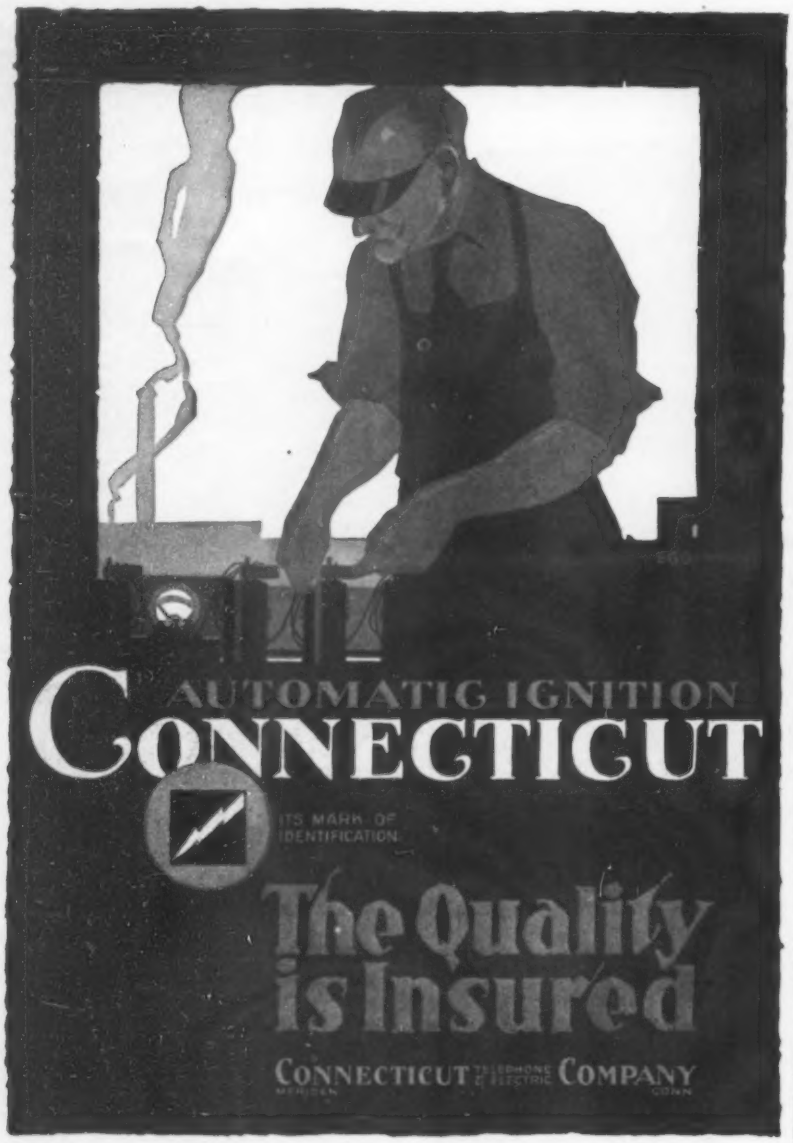

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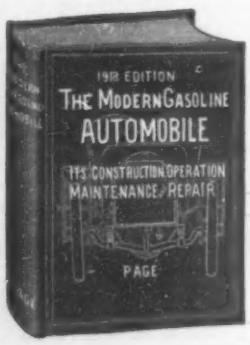

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SCIENTIFIC AMERICAN OFFICE

233 BROADWAY **NEW YORK**

How New York City is Preparing to Meet an Air Raid

SHORTLY after we entered the great war there appeared in the editorial columns of this journal a warning of impending air raids on our coastal cities. Using the exploits of the "U-53" and the "Deutschland," as well as the collapsible seaplanes employed on warships, by way of proving the mechanical possibility of the project, it was shown that the Germans would no doubt attempt to bombard New York city from the skies in the near future. One by one certain writers and now the authorities have accepted the possibility and probability of such raids, and at present, with the U-boats operating off our coasts, measures are being taken to safeguard our cities.

On June 4th Police Commissioner Enright of New York city issued the following statement:

"The Police Department desires to notify all residents of this city, through the press, that in the event of a raid on this city by enemy airplanes the following signals will be given:

"Siren horns or whistles will be sounded continuously for ten minutes. When this signal is given every one should immediately open the windows of their homes or offices and go at once to the cellar of the premises. After the danger has passed a signal will be given by short blasts of siren horns or whistles at intervals of one minute each for a period of 20 minutes."

On the same day, after nightfall, electric signs and all lights, except street lamps and lights in dwellings, were ordered extinguished by the police authorities. Aviators from Governor's Island flew over the city in order to determine to what extent street lamps alone might serve as guides for raiders. While the result of their observations is not definitely known at this writing, there is reason to believe that street lamps and lights in dwellings will have to be darkened as in the case of London and Paris. New York city, unfortunately, is surrounded by waterways which plainly delineate the various parts of the city on a moonlight or starry night, so that an airman with a map or with a slight knowledge of the metropolitan district would have little trouble finding his way to any desired part of the city.

However that may be, we are assured by the authorities that steps were taken some months ago with regard to anti-aircraft preparations. Suitable guns have been installed not only in the city but also in a wide circle about the city. Come what may, the raiders will not find New York undefended.

Our Wartime Barrel of Oil

(Concluded from page 541)

with it as they saw fit; but with national fuel shortage at stake the control of such properties by the Government becomes at once evident.

Petroleum conservation is a subject which lends itself to treatment under three distinct subdivisions: First, the production; second, the refining; and third, the consumption.

Taking up the first phase of the subject, it is well to point out that the wastage of natural gas, while highly important, is not directly concerned with the petroleum question. It is a by-product, albeit an important if not vital one. But the main wastage is to be found in the exploitation of the oil properties. Instances are legion in which fields have been abandoned after being only partially worked, due to poor methods of extracting the oil. Again, oil sands have been allowed to become flooded with water, despite the fact that they contained thousands of barrels of oil, through gross carelessness and indifference. Indeed, we are told by experts that in many cases only 10 per cent of the oil contained in oil sands is extracted, and that the maximum rarely reaches 70 per cent.

Then there is the matter of storage, which makes for further and heavy losses because of unsatisfactory methods. As high as five per cent of the petroleum is lost through evaporation and seepage during storage and transportation.

Fortunately, oil men are now beginning to take the necessary precautions, and the wastage in this direction is being materially reduced. In many cases the oil is not permitted to accumulate in big lakes, there to evaporate and escape through the ground before it can be shipped to the refinery. As will be noted in some of the accompanying illustrations, oil men are now controlling the accumulation of oil; that is to say, the well is piped and the oil passed through a flow-regulating machine so that the flow can be controlled. When the oil is wanted from the well, it is permitted to pass on to the lake or reservoir, and when the latter is full, the flow is shut off entirely or reduced materially. Obviously, this method is a vast improvement over the former one of letting the oil spout out freely and accumulate in poorly enclosed basins.

When it comes to the matter of refining, less fault can be found, although there is still vast room for improvement. The wastage in this phase of the industry is largely in the direction of insufficient application of the crude oils or by-products of refinement. However, chemists are ever at work on this problem, and it is not at all impossible that additional uses will be found for all the heavier products of refining which are now of little commercial value.

If gasoline were employed solely in gasoline engines, the wastage of this valuable commodity would be materially reduced. But it is a fact that petroleum products are used for purposes where other fuels could just as well be employed. It is said that fully one-fourth of the country's oil is being used under boilers, while another large percentage is being used in making artificial gas, despite the large coal supplies available for both those purposes. Still another source of steady and serious drainage on our petroleum resources is the export quota—20 per cent of the total production, which is sent abroad. While not wastage in the strict sense of the word, it nevertheless represents a heavy outgo of an essential and limited commodity.

Our gasoline has got to be conserved, if we are to continue enjoying those vehicles and engines operating on that fuel. Fortunately, the Government, through the Fuel Administration, is beginning to control the oil industry very much the same as the coal industry. Oil Director M. L. Requa has appointed T. A. O'Donnell of Los Angeles to be his chief aide with the special task of promoting greater co-operation between all concerns connected with the oil business.

Many of the wastes so common in the past will no doubt soon cease to exist; and much of the drain on our oil resources may some day be curtailed with the extensive development of water power which is now going to waste. All in all, our water power, coal and petroleum are all inter-allied, and the development of one soon benefits the others.

Shoes for Soldiers

(Concluded from page 545)

heel. After a master last has been fashioned by hand, duplicates are quickly turned out by lathes.

The next step in shoe-making is the preparation of patterns used for cutting the various parts of the upper portion of the shoe. The position of designer in a large shoe factory is an important one, as often the volume and permanency of trade secured by his company depends upon the styles turned out. The initial set of shoe patterns is cut in sheet iron by hand, and duplicates are reproduced in metal or cardboard by the pattern machine. Every shoe requires a large number of patterns, one for each separate piece which enters into its makeup.

Leather for shoe-making is purchased from tanneries, where it is prepared either by the vegetable or by the chemical process. Where the bark of trees is used to tan leather, months are required to complete the process. Of late years mineral substances, such as chrome alum, have come into general use for tanning and less time is required than with tan bark. This last is known as the "chrome tanning process."

Factory Production in Seven League Boots

YOU and all American manufacturers are struggling against a tremendous handicap. Labor is almost impossible to get. The army draft is thinning the ranks of your office clerks. New equipment is practically off the market. Coal is scarce and transportation uncertain. But in spite of these conditions every mail brings the cry for more production. Output must increase with present equipment of machinery and hands. But how?

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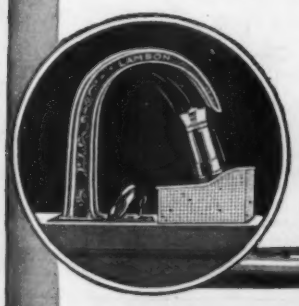

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The Motorboat and the Torpedo

ONE of the significant developments of the war has been the installation of the torpedo tube on the motorboat. At the first blush it would be thought impossible to carry upon the deck of a lightly constructed craft of this type a torpedo tube which, together with the weight of its torpedo, would constitute a heavy load for a craft of the limited size and displacement of a motorboat.

However, the problem has been worked out and we have noticed photographs showing motorboats which carry a single torpedo tube on the after part of the deck. More than that, the torpedo-motorboat has given a most excellent account of itself during the war. In the raids against the Austrian naval bases, and against Ostend, made by craft of this kind, the Italians have been successful within the past few months in sinking two Austrian armored ships, the "Wien" and the "Viribus Unitis." The "Wien" was a ship of 6,000 tons displacement, mounting four 9.4-inch and six 5.9-inch guns and armed with a 10½-inch belt. The "Viribus Unitis" was the latest and most powerful of the Austrian dreadnaughts, with a displacement of 20,000 tons, and it was, protected by an 11-inch belt and armed with twelve 12-inch and twelve 5.9-inch guns.

The Current Supplement

BIG guns are playing the principal role in the great war, and wonderfully rapid progress has been made in both their design and production during the last four years. Naturally any information in relation to the development of artillery during the war is of universal interest, and the article on *Ordnance on the Allied Front,* by a prominent British authority, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2215, for June 15th, will be widely appreciated. Not long ago a fish was caught at Zanzibar that had curious markings upon its tail resembling Arabic characters. A note on *A Mysterious Fish with Arabic Markings* gives a brief account of the matter, and is accompanied by an excellent illustration. Another instalment of the papers on *Anomalies of the Animal World,* accompanied by illustrations, will be found in this issue. *Battle Telephones* tells how orders and information are transmitted along the fighting lines in Europe, and the article is illustrated by a number of excellent photographs. The concluding lecture on *Problems of Atomic Structure* will be found in this issue. While accurately cut screw threads have always been of importance in mechanical construction, they have become especially so in the making of many descriptions of munitions required in the war, such as in the fitting together of shell parts, time and percussion fuses, breach mechanism of cannon and the like; and special attention has been given to the matter during the last few years. An article in the current issue of the SUPPLEMENT on *Testing Screw Threads* describes an optical projection apparatus which enables great accuracy to be secured, and it is illustrated by several drawings that explain the device, and its method of operation. *The Coral Reef Problem* discusses the vexed problem of the origin of the atolls and barrier reefs found in tropical seas. Other articles of general interest in this issue include *Radiation from System of Electrons; Occultation of a Star by Saturn's Rings,* illustrated by a drawing; *Submersible Cargo Vessels; Acid-Proof Nickel- Copper- Tungsten- Iron Alloys; Hydrogen Reactions and Catalysts* and *Migratory Butterflies.*

Surgery by Mathematical Formula

(Concluded from page 545)

fashion the hypochlorite can be made in a few minutes where the germicide as originally prepared took many hours. Suitable tests are prescribed by which it is possible to determine exactly the strength of the hypochlorite and its freedom from alkalinity.

The hypochlorite solution, while benign in its action towards the wound surfaces, nevertheless is destructive to micro-organisms and able to dissolve and to

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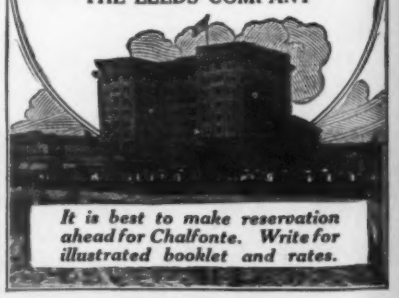

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detach dead tissues—thus removing mechanically the breeding places and retreats of the bacilli. The erosive work of the germicide invariably ceases when it reaches vitalized body substance, and, therefore, does not provoke secondary hemorrhage.

It is absolutely essential to success that the wound, particularly if a deep one, be opened up freely by the knife in order to remove bits of clothing, fragments of shell, blood clots, and splinters of bone which otherwise would form microbial nests. When the damaged area has been satisfactorily cleansed by means of the hypochlorite, the healthy granular surfaces can be brought together and healing accomplished without further complications. The apparatus by means of which the solution is introduced into the wound has already been described in these columns (Feb. 23d, 1917). But it must be applied until the injury is indubitably sterile from a surgical viewpoint; and the surgeon can not depend upon his unaided eye—as was heretofore the common practice—to decide when the injury can be closed. Here Dr. Carrel has introduced another novelty.

The bacteriological condition of the injury must be established by a microscopic examination made every two days. Secretions are taken from several parts of the raw surfaces—particularly those where bacteria would find securest lodgment—and smears are made upon thin strips of glass. The smears are dried and then stained to make the micro-organisms more readily discernible. The number of germs in each microscopic "field" of 1.8 mm. is counted, if they do not exceed 50 or 100. The tally is recorded upon a bacteriological chart, and thus, day by day, the attending physician has a sure indication of progress toward sterilization. Finally, when the microscope discloses but one germ in five or ten fields it is safe to close the wound without fear of reinfection.

But the surfaces of the wound may give microscopic evidence of sterility and yet the injury be, in fact, infected. How, then, does Dr. Carrel guard against overhaste in closing? Here is the phase of the problem where mathematics comes into play. This surgeon-scientist discovered a decade ago that a wound's rate of healing in a healthy person is determined primarily by its initial area. At his hospital at Compiegne, France, this phenomenon was subjected to searching study, and Captain de Nouy, a physicist, evolved a formula which gives an algebraic value applicable to the average patient with an uninfected hurt. That is to say, by this formula it is practicable to foretell the day of ultimate closure and to determine the diurnal rate of healing or repair. This is based upon the area of the injury at the time of first observation, and from that measurement is developed a so-called "control curve" by which the subsequent repairing of the wound is checked up.

Every four days the area of the wound is remeasured. This is done by making a tracing with India ink upon a sheet of thin sterilized celluloid which is laid upon the hurt. The contour thus established is transferred to paper and the area ascertained by means of a planimeter. The figure obtained is plotted and if the rate of healing as thus revealed is found to vary in a marked degree from that of the control curve, the lag is a sure sign that the injury is infected. If this infection is not upon the visible surface of the hurt the surgeon must explore for it. The seat of trouble will then be found in some recess or by-path of the wound which has escaped notice and been beyond the reach of the liquid germicide. The bacteriological chart and the repair graph must, therefore, agree in their general index of progress, and the surgeon has by these means a check and a countercheck upon the healing processes.

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But it also has a thousand household uses. And these pictures suggest some.

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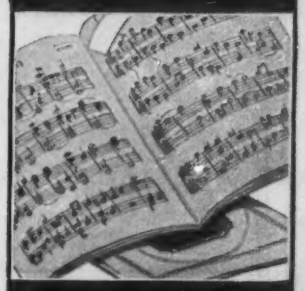
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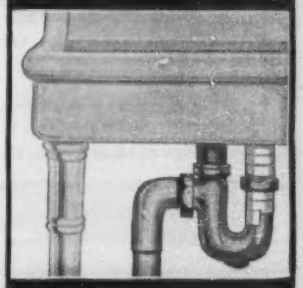

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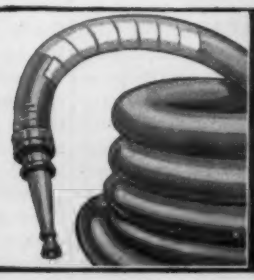

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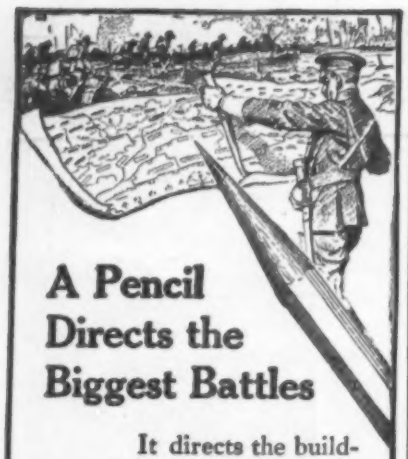

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considered infected wounds at the very beginning and are treated as such. . . . Many wounds, which come to us infected clear up most marvelously, and new injuries treated early with the solution heal by first intention." It is worth while telling just how ambulatory cases are taken care of at this particular establishment, because it illustrates what can be prevented by prompt action even where men labor in a dirty germ-laden environment. Manifestly, the walking patient calls for a different procedure from the man abed. To quote, "A dressing is applied over the wounded area in such a way that the denuded or exposed tissue laceration is free from pressure. First, the wound is thoroughly, but carefully, cleaned with Dakin's solution, either by spray or swabbing off with cotton. Pressure is made around and about the outside edges of the wound, previously covering the uninjured parts, to be included in the bandage, with vaseline gauze. The bandage is then applied and the patient is instructed to pour through the depression in the bandage where the opening of the original dressing appears, sufficient of the Dakin's solution, every two hours, to thoroughly wash out the chamber within. The patient is supplied with a bottle of the Dakin solution sufficient to carry him over to the next dressing. When the injury is a small one, the dressing is applied as before mentioned, and the patient is supplied with a medicine dropper in addition to the bottle of the solution, and is instructed about the use of the solution."

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Potash Independence

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Making America Self-Supporting

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quires so much technical skill, the utilization of intricate scientific methods, and the outlay of large sums of money in its inauguration. The European sugar-beet seed growers have been engaged in the industry for decades. Through scientific research extending over a period of nearly a century they have succeeded in producing strains of seed of such high grade that it seemed impossible to increase the standard of quality appreciably. In addition, women and children do the bulk of the field work on European sugar-beet seed farms; and the low wage paid to this class of labor has made it possible for foreign growers to bring the cost of production to a point so low that, with our high-priced labor, we cannot produce sugar-beet seed at anywhere near the cost at which it can be grown in Europe. And so, while some of the American factories had been experimenting for several years in the growing of sugar-beet seed, but little commercial seed had been produced in this country prior to the outbreak of war.

In this connection, it may be of interest to note that ordinarily five years of painstaking scientific work are required before a crop of commercial beets is harvested. For instance, let us suppose that in the spring of the first year the original selected seed is planted. The beet is a biennial; so in the fall those plants which pass a physical selection of foliage and root and a chemical test of the root are siloed for the winter, where they are kept from frost and heating. These are known as "mother" beets. In the spring of the second year these "mothers" are uncovered and after passing a second chemical test, are planted in the field and in the fall yield a crop which is known as "élite" seed. In the spring of the third year, the "élite" seed is planted closely in order to grow a crop of small beets, called "stecklinge," which are gathered in the fall and preserved in silos until the next spring. In the spring of the fourth year, the "stecklinge" are planted and in the fall they produce a crop of commercial seed. This is planted the next spring, producing beets from which sugar is extracted in the fall, five full years from the time the scientific work began. If the cycle started this spring it would be the fall of 1922 before the first definite returns were in.

Notwithstanding the intricacies of sugar-beet seed culture, and the tendency of the American beet-sugar manufacturers to import their seed from foreign concerns which had made this their sole business for many decades, after the difficulties of 1914 these manufacturers began to realize the precarious condition of their industry as long as it was dependent upon foreign countries for its seed supply, especially during the continuance of the present war.

It therefore was decided, in the summer of 1915, to take up in earnest the matter of producing their own seed in the United States. In the fall of that year a coöperative beet-seed company was organized with a capital of $100,000, and several of the individual beet-sugar companies which had conducted experiments in beet-seed growing began increasing their efforts along these lines. It was well understood that under the most favorable conditions, it would be many years before sufficient home-grown seed could be produced to supply the annual requirements of the industry, but while climatic conditions were unpropitious during the first year of the operation of the company, a fairly good start was made. The capital of the company has since been increased to $300,000 and considerable land has been bought and rented for beet-seed culture, with the results that practically one-third of the seed required for this year's planting was produced in the United States by the coöperative seed company and the individual sugar companies which have extended their work in the production of home-grown seed. While the cost of production is considerably higher than in Europe, there is reason to believe that strains of seed of a higher quality than the European strains, both as to tonnage per acre and sugar content, will be produced.

Three centuries ago Shakespeare penned the words, "Sweet are the uses of adversity," and these words are as true today as they were 300 years ago. Had the American beet-sugar companies not passed through the vicissitudes of the present war, had they not met with almost unsurmountable difficilties in securing foreign-grown beet seed, it is more than likely that we should still have continued to be dependent upon Germany for this most important essential in the manufacture of beet sugar, and that that country would have continued to reap the benefits of this valuable market. As it is, with the energetic efforts being put forth by the domestic industry to produce at home all of its seed requirements, the indications are that when peace conditions again prevail, Germany will awake to find that she has lost a valuable annual market for over a million dollars worth of sugar-beet seed; a new and important American industry will have been established, and the American beet-sugar producers will have become independent of foreign countries for their supply of beet seed.

Launch of the First Fabricated Ship

(Concluded from page 551)

ship before she was launched. The boilers will be oil fired, the fuel being carried in the double bottom in more than sufficient quantity to cover the round trip to Europe.

We have spoken of the "Agawam" as a "fabricated" ship, which means that the majority of the work upon her has been done at various mills, foundries, machine shops, etc., throughout the country; the work at the shipyard consisting merely in the erection of the ship with a minimum amount of plate and frame bending to be done at the yard. Approximately 27 steel mills, 56 fabricating plants, and 200 foundries, machine, pipe, foundry and equipment shops are engaged in the production of the parts to make up the finished ships. It is the belief of the company that, when the yard is in full swing, and the steel and general equipment are coming in on time, it will be possible to launch a ship every two days.

The name, "Agawam," which was selected by Mrs. Woodrow Wilson, means literally "Great Salt Meadows of the Atlantic Coast."

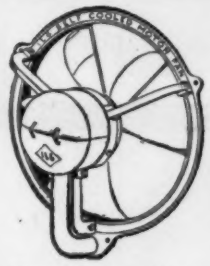
Collecting Rubbish by Motor Trucks

(Concluded from page 552)

the scientific system under which the fleet of trucks is operated. Housewives place the ashes and rubbish in cans, boxes, barrels and other receptacles along the curbings and a few hours later they are dumped in the body of the trucks. In order to increase the load capacity the bodies of the trucks are built with 24-inch extension sides. This extra height permits each truck to haul 12 cubic yards on a single trip. Each day's work is divided into three sections and each section is in charge of a foreman who has four trucks and a crew of eight men under his supervision. There is a driver for each truck, a man who lifts the ashes from the curbings and another helper who distributes the loads in the truck. The labor of loading is greatly simplified by special openings in the sides of the bodies through which the baskets, boxes and cans are passed. Six trucks are loaded simultaneously in three sections and the motors are kept running continually from morning until night. Despite this the trucks have proven economical to operate and have earned a good profit.

After a truck is loaded, a heavy canvas cover is placed over the body to prevent the ashes falling to the pavement and being blown by the wind. The average distance from the point of collection to the dump where the ashes are deposited, is six miles one way, and in making this haul the trucks travel over definite routes through the city's most congested business thoroughfares.

The ashes are deposited in an old swamp adjoining the League Island Navy Yard, at the extreme north end of Broad Street. The corporation is paid for the ashes hauled to the dump by a wealthy Philadelphia philanthropist who plans eventually to convert the swamp into a public park and playground.



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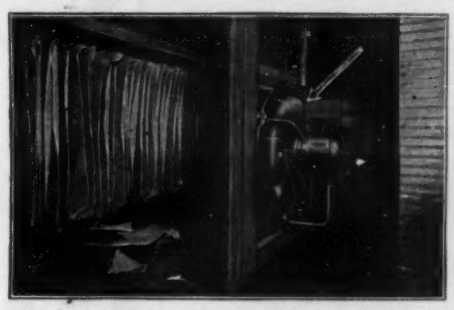

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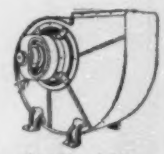

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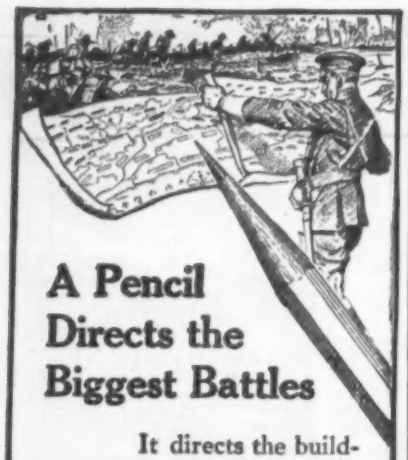

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Beach Haven has the best combination of sea shore features on the Atlantic Coast. ¶ Matchless bay for sailing, always good fishing, perfect beach and bathing. ¶ The ENGLESIDE has all the modern conveniences, private baths with salt and fresh water, and is a *home* as well as a hotel. *Sure relief from hay fever. Open June 20th to October 1st.* Send for booklet.
THE ENGLESIDE COMPANY, Inc., Owners
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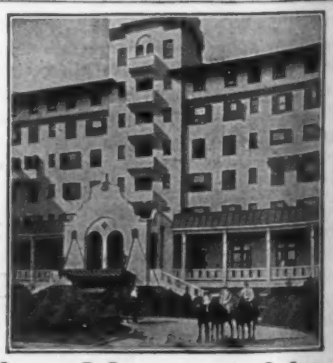

New Monterey Hotel
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Capacity 500. All outside rooms. Hot and cold salt water in all bathrooms. White service. Orchestra. Largest, most modern hotel on North Jersey Coast.
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quires so much technical skill, the utilization of intricate scientific methods, and the outlay of large sums of money in its inauguration. The European sugar-beet seed growers have been engaged in the industry for decades. Through scientific research extending over a period of nearly a century they have succeeded in producing strains of seed of such high grade that it seemed impossible to increase the standard of quality appreciably. In addition, women and children do the bulk of the field work on European sugar-beet seed farms; and the low wage paid to this class of labor has made it possible for foreign growers to bring the cost of production to a point so low that, with our high-priced labor, we cannot produce sugar-beet seed at anywhere near the cost at which it can be grown in Europe. And so, while some of the American factories had been experimenting for several years in the growing of sugar-beet seed, but little commercial seed had been produced in this country prior to the outbreak of war.

In this connection, it may be of interest to note that ordinarily five years of painstaking scientific work are required before a crop of commercial beets is harvested. For instance, let us suppose that in the spring of the first year the original selected seed is planted. The beet is a biennial; so in the fall those plants which pass a physical selection of foliage and root and a chemical test of the root are siloed for the winter, where they are kept from frost and heating. These are known as "mother" beets. In the spring of the second year these "mothers" are uncovered and after passing a second chemical test, are planted in the field and in the fall yield a crop which is known as "élite" seed. In the spring of the third year, the "élite" seed is planted closely in order to grow a crop of small beets, called "stecklinge," which are gathered in the fall and preserved in silos until the next spring. In the spring of the fourth year, the "stecklinge" are planted and in the fall they produce a crop of commercial seed. This is planted the next spring, producing beets from which sugar is extracted in the fall, five full years from the time the scientific work began. If the cycle started this spring it would be the fall of 1922 before the first definite returns were in.

Notwithstanding the intricacies of sugar-beet seed culture, and the tendency of the American beet-sugar manufacturers to import their seed from foreign concerns which had made this their sole business for many decades, after the difficulties of 1914 these manufacturers began to realize the precarious condition of their industry as long as it was dependent upon foreign countries for its seed supply, especially during the continuance of the present war.

It therefore was decided, in the summer of 1915, to take up in earnest the matter of producing their own seed in the United States. In the fall of that year a coöperative beet-seed company was organized with a capital of $100,000, and several of the individual beet-sugar companies which had conducted experiments in beet-seed growing began increasing their efforts along these lines. It was well understood that under the most favorable conditions, it would be many years before sufficient home-grown seed could be produced to supply the annual requirements of the industry, but while climatic conditions were unpropitious during the first year of the operation of the company, a fairly good start was made. The capital of the company has since been increased to $300,000 and considerable land has been bought and rented for beet-seed culture, with the results that practically one-third of the seed required for this year's planting was produced in the United States by the coöperative seed company and the individual sugar companies which have extended their work in the production of home-grown seed. While the cost of production is considerably higher than in Europe, there is reason to believe that strains of seed of a higher quality than the European strains, both as to tonnage per acre and sugar content, will be produced.

Three centuries ago Shakespeare penned the words, "Sweet are the uses of adversity," and these words are as true today as they were 300 years ago. Had the American beet-sugar companies not passed through the vicissitudes of the present war, had they not met with almost unsurmountable difficulties in securing foreign-grown beet seed, it is more than likely that we should still have continued to be dependent upon Germany for this most important essential in the manufacture of beet sugar, and that that country would have continued to reap the benefits of this valuable market. As it is, with the energetic efforts being put forth by the domestic industry to produce at home all of its seed requirements, the indications are that when peace conditions again prevail, Germany will awake to find that she has lost a valuable annual market for over a million dollars worth of sugar-beet seed; a new and important American industry will have been established, and the American beet-sugar producers will have become independent of foreign countries for their supply of beet seed.

Launch of the First Fabricated Ship

(Concluded from page 551)

ship before she was launched. The boilers will be oil fired, the fuel being carried in the double bottom in more than sufficient quantity to cover the round trip to Europe.

We have spoken of the "Agawam" as a "fabricated" ship, which means that the majority of the work upon her has been done at various mills, foundries, machine shops, etc., throughout the country; the work at the shipyard consisting merely in the erection of the ship with a minimum amount of plate and frame bending to be done at the yard. Approximately 27 steel mills, 56 fabricating plants, and 200 foundries, machine, pipe, foundry and equipment shops are engaged in the production of the parts to make up the finished ships. It is the belief of the company that, when the yard is in full swing, and the steel and general equipment are coming in on time, it will be possible to launch a ship every two days.

The name, "Agawam," which was selected by Mrs. Woodrow Wilson, means literally "Great Salt Meadows of the Atlantic Coast."

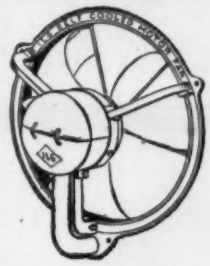
Collecting Rubbish by Motor Trucks

(Concluded from page 552)

the scientific system under which the fleet of trucks is operated. Housewives place the ashes and rubbish in cans, boxes, barrels and other receptacles along the curbings and a few hours later they are dumped in the body of the trucks. In order to increase the load capacity the bodies of the trucks are built with 24-inch extension sides. This extra height permits each truck to haul 12 cubic yards on a single trip. Each day's work is divided into three sections and each section is in charge of a foreman who has four trucks and a crew of eight men under his supervision. There is a driver for each truck, a man who lifts the ashes from the curbings and another helper who distributes the loads in the truck. The labor of loading is greatly simplified by special openings in the sides of the bodies through which the baskets, boxes and cans are passed. Six trucks are loaded simultaneously in three sections and the motors are kept running continually from morning until night. Despite this the trucks have proven economical to operate and have earned a good profit.

After a truck is loaded, a heavy canvas cover is placed over the body to prevent the ashes falling to the pavement and being blown by the wind. The average distance from the point of collection to the dump where the ashes are deposited, is six miles one way, and in making this haul the trucks travel over definite routes through the city's most congested business thoroughfares.

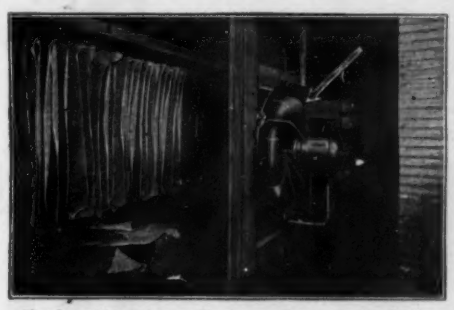
The ashes are deposited in an old swamp adjoining the League Island Navy Yard, at the extreme north end of Broad Street. The corporation is paid for the ashes hauled to the dump by a wealthy Philadelphia philanthropist who plans eventually to convert the swamp into a public park and playground.



TRADE ILG MARK

SELF-COOLED MOTOR PROPELLER FANS

Can be used to *exhaust* heat, smoke, vapor, steam, acid fumes and can be used to *blow in* for *cooling*, drying, circulating.

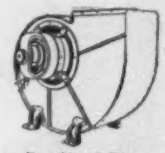


Showing self-cooled propeller fan used to dry leather belting

We have solved ventilating, cooling and drying problems for all kinds of manufacturing plants.

Ilg Propeller Fans and Blowers are:

Low in power consumption
Quiet running
Durable
Covered by one guarantee as we build Fan and Motor



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We can send a man to see you from our nearest branch.

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BRANCHES—ALL LARGE CITIES

Navy Needs At Once 1,000 Gas Engine Men

The Naval Reserve Force must enroll at once 1,000 men experienced in the operation and maintenance of gasoline engines.

This is an urgent call. The men are required for immediate duty. They will be rated as Machinist's Mates.

Age limits are eighteen to thirty-five inclusive. Applicants must be American citizens. Draft registrants with letters from their local boards will be accepted.

Apply at Naval Reserve Enrolling Office, 51 Chambers Street, New York, or any Navy Recruiting Station.

National War Savings Day June 28th

That's the day we sign up.

That's the day we tell Uncle Sam just how hard we want to win this war. That's the day our government has officially set for us to purchase War Savings Stamps.

On June 28th every man, woman and child in the United States will be called upon to pledge his or her full quota of War Savings Stamp purchases for 1918.

You will be expected to pledge the **full** amount that you can afford—no more—but by the same token, no less.

In every state, county, city, town and village the War Savings Committees are preparing for this big patriotic rally of June 28th. Unless you have already bought War Savings Stamps to the $1,000 limit, get busy with paper and pencil and figure out the **utmost** you can do.

Remember this. You take no chances when you go the limit on War Savings Stamps. They are the best and safest investment in the world. They pay you 4% interest compounded quarterly. They **can't** go below par. You can get back every dollar you put into War Savings Stamps **any time you need it.** You can turn them in at the Post Office **any time** for their full value plus interest.

Uncle Sam is asking hundreds of thousands of men to **give** their lives to their country. He is asking you only to **lend** your money.

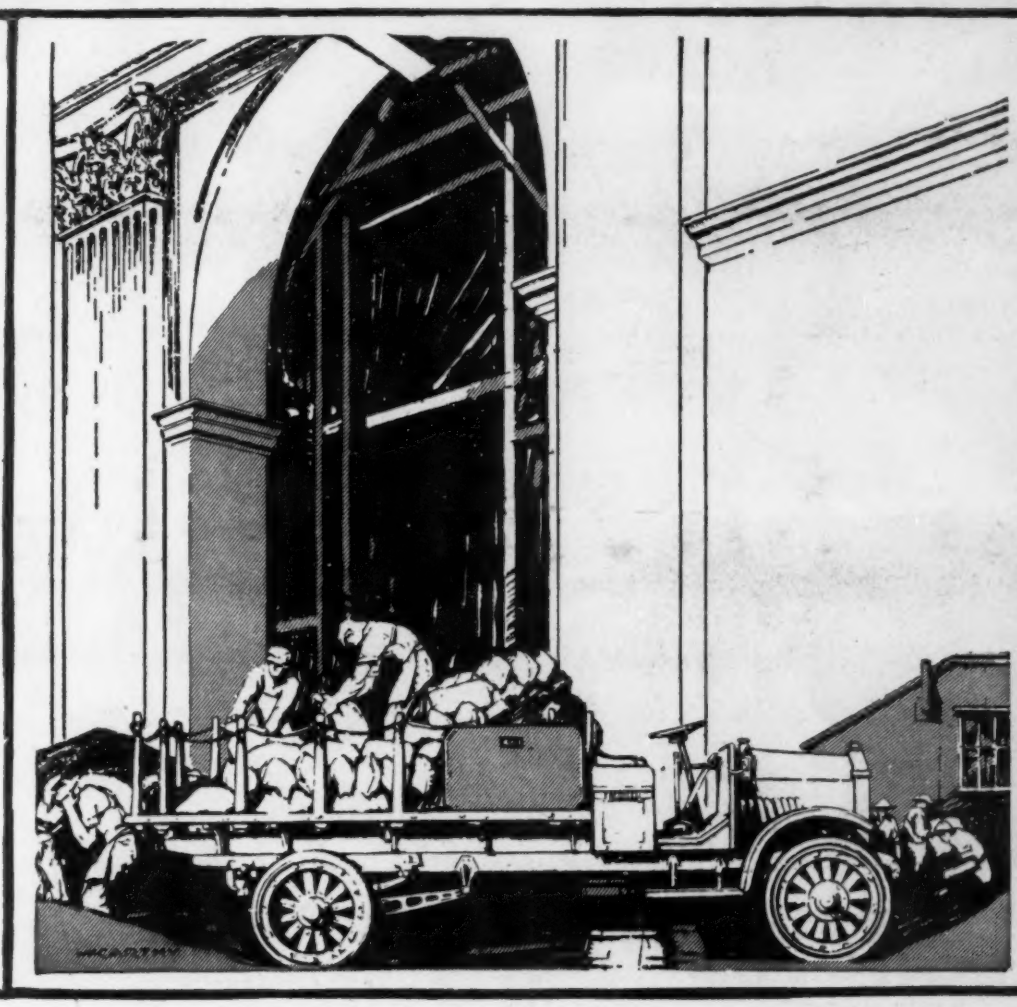
What are **you** lending?

National War Savings Committee, Washington.

W.S.S.
WAR SAVINGS STAMPS
ISSUED BY THE
UNITED STATES
GOVERNMENT

Contributed through Division of Advertising *United States Gov't. Comm. on Public Information*

This space contributed for the Winning of the War by
THE PUBLISHERS OF THIS MAGAZINE



Construct

Construct, upbuild, speed up in your business.

It is essential that the business of the nation move forward—that back of our iron-hearted men in Khaki and the big guns at the front there will be prosperous industries to provide food, equipment and ammunition to WIN THE WAR.

For every motor truck you install in your business you release two or three men for other productive labor—you increase your productive capacity without increasing your pay roll.

Install massive, powerful Selden "In-Built Quality" Trucks—for there is no economy, no profit in the operation of trucks that are not possessed of the stamina of Selden Trucks—that are not physically able to render the dependable, continuous, economical, and therefore profitable, service that Selden Trucks have proved time and time again their ability to render. *Buy a SELDEN—It's ALL Truck.*

One to Five Ton Worm and Internal Drive. Write for full information on your haulage problems.

SELDEN TRUCK SALES COMPANY

ROCHESTER, N. Y., U. S. A.

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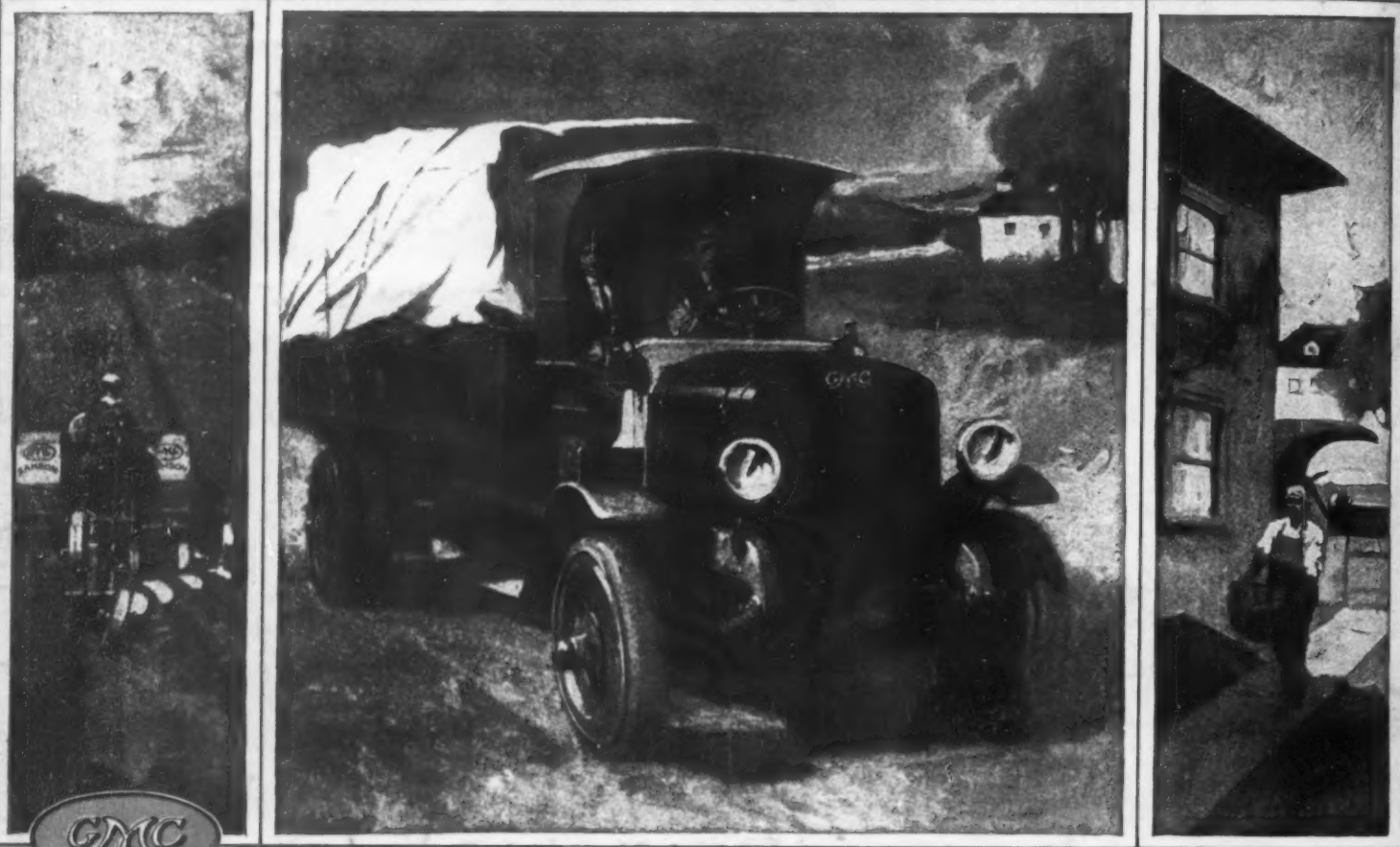
GMC Trucks Are Bringing Us the Necessities of Life



TODAY'S SHORT CUT BETWEEN SUPPLY AND DEMAND

BACK on the farm the crops that are to feed us flourish under the arts of modern agriculture.

Cultivating the soil is the first big problem in feeding this nation, and nations across the sea.

The next big problem is getting these things to eat from the source of supply to the consumer.

It's a bigger problem now than ever.

Clogged with traffic, the great arteries of rail transportation are struggling to bear the load.

Every traffic auxiliary must be called on. So GMC Trucks are shouldering a big share.

GMC Trucks are breaking through the barriers and bringing to man, woman and child the things they need.

GMC Trucks are built to meet the demands of heaviest traffic in this new age of transportation.

Every GMC is road tested.

GMC Samson Farm Tractor—also made by General Motors Truck Company

Let Your Next Truck Be a GMC

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GMC TRUCKS

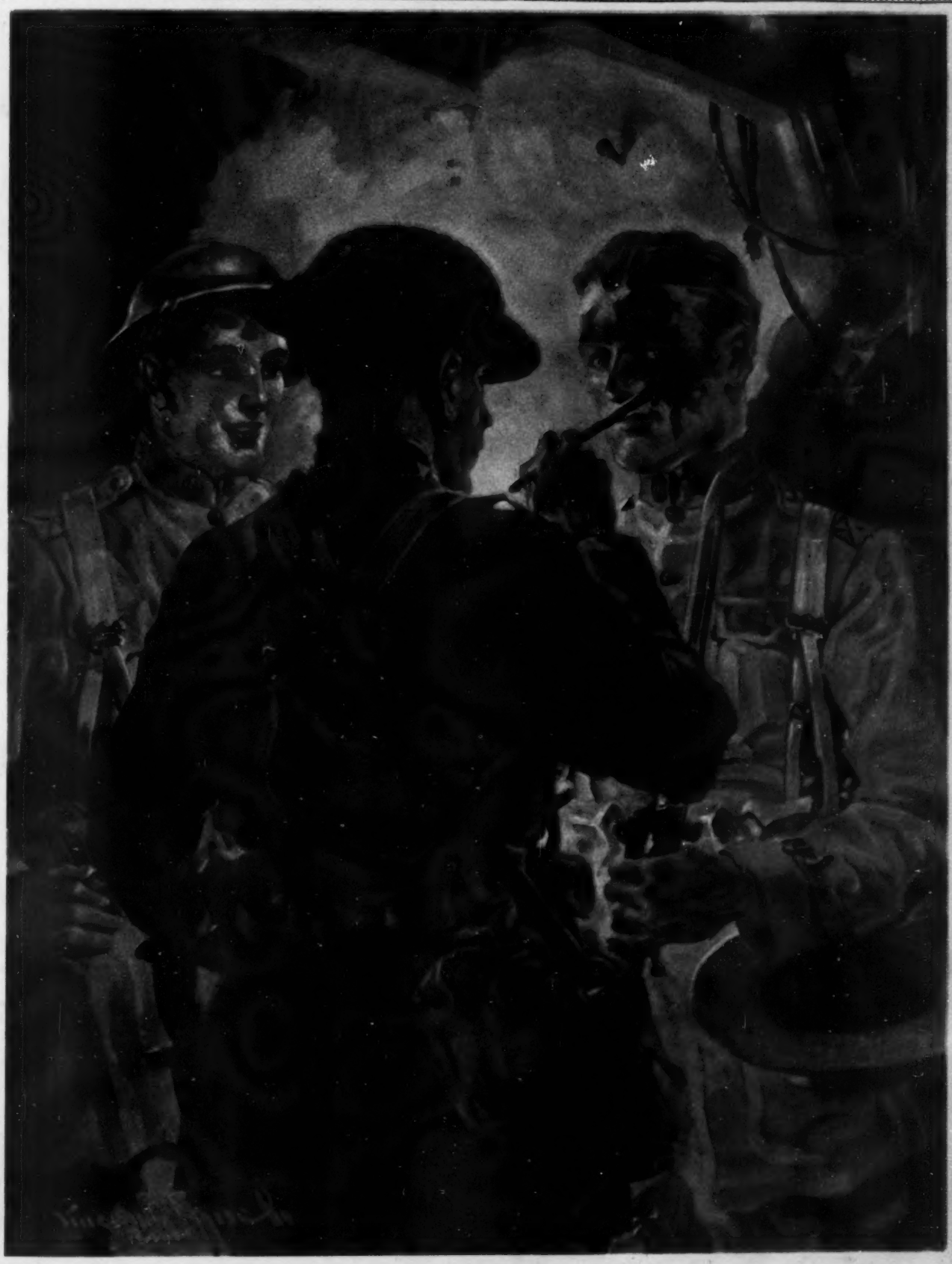
Our subscribers are requested to note the expiration date that appears on the wrapper in which they receive their copies of SCIENTIFIC AMERICAN. If they will send in their renewal orders at least two weeks prior to the date of expiration, it will aid us greatly in rendering them efficient service.

NOTICE TO READER

When you finish reading this magazine, place a one cent stamp on this notice, mail the magazine, and it will be placed in the hands of our soldiers or sailors destined to proceed overseas. NO WRAPPING, NO ADDRESS.
A. S. Burleson, Postmaster General.

JUN 24 1918

SCIENTIFIC AMERICAN

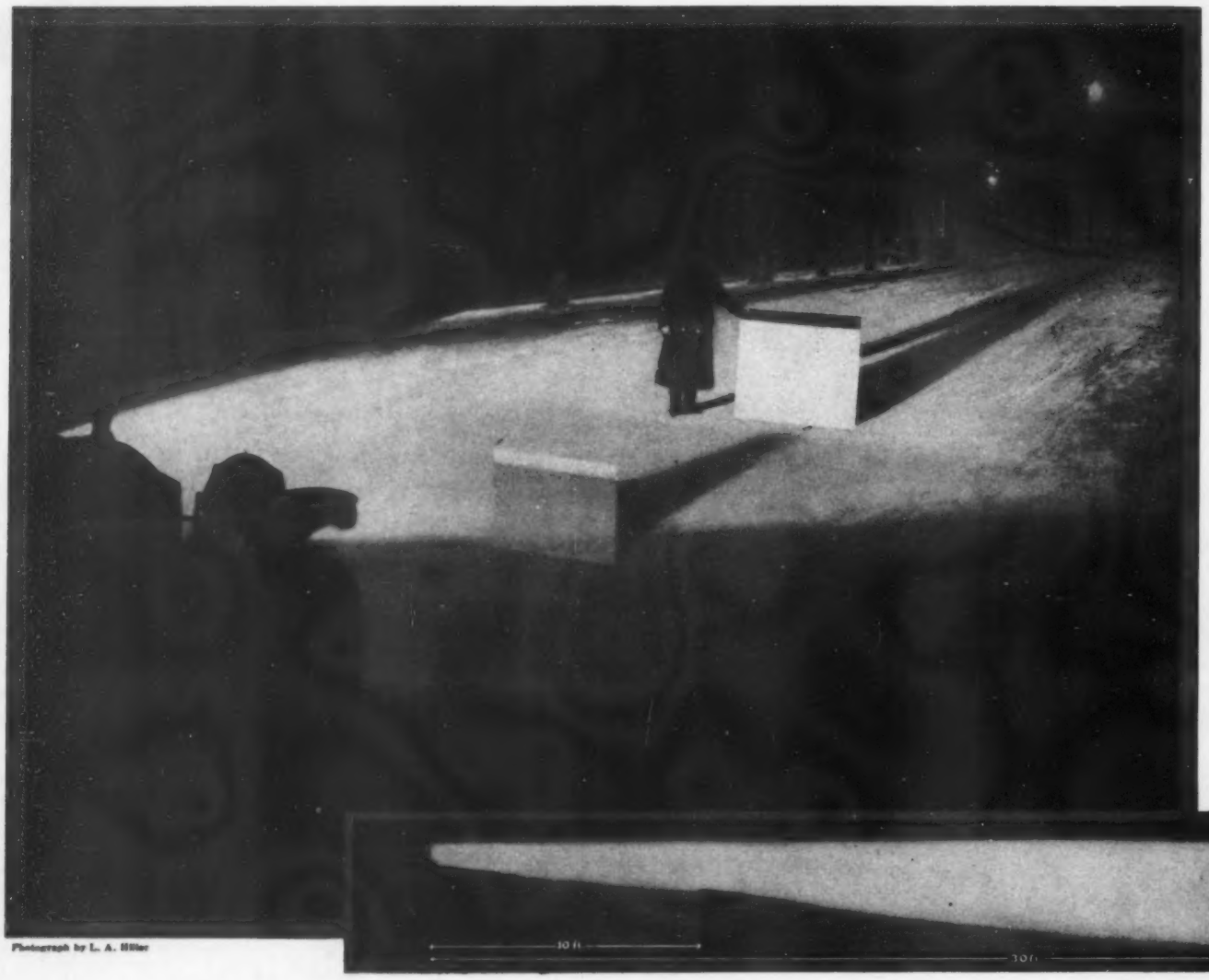


INFANTRYMAN HAVING HIS FACE BLACKENED BEFORE STARTING ON A NIGHT RAID [See page 569]

June 22, 1918

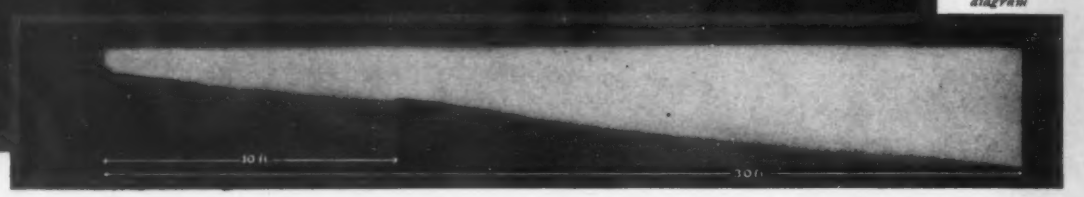
Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents



Photograph by L. A. Miller

Below—cross sectional diagram



What the double target test proves

Why the Conaphore is the only headlight glass that passes

YOU know that ordinary diffusing or prismatic lenses dump so much of the light directly in front of the car, that long range is impossible.

This is why the double target test is the most important test of headlight efficiency.

Engineers have found it the best proof of long range, no glare, and side-light.

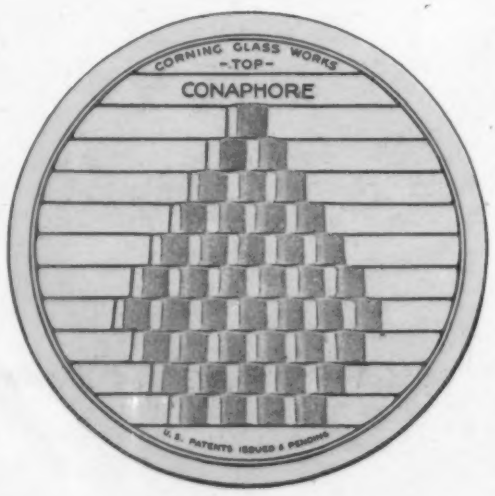
How this test is made

Two targets are set up in the road. The first is 22 inches high, and is placed 10 feet ahead of the car. The second, 4½ feet high, is placed 30 feet ahead. A horizontal line is drawn across the second target at a height of 42 inches above the road.

The Conaphore beams shoot over the first target and brilliantly illuminate the second target *below the 42 inch line, but not above it.*

This gives positive proof that light from Conaphores is not dumped in the foreground, but shoots down the road with sufficient intensity to produce 500 feet of strong driving light. The spread of the light at each side of the targets gives evidence of ample side-light.

This test also proves that Conaphore beams never rise high enough to blind an approaching motorist or pedestrian. *Legal everywhere.*



The Conaphore has a smooth front surface. Easily cleaned. Does not clog with dust or mud

Noviol Conaphores are best

Conaphores are made of yellow-tint Noviol Glass (*patented*)—the only device which eliminates "back-glare" on foggy or dusty nights, and provides a light that is easy for your eye to follow. Clear glass Conaphores are equally efficient, except for this exclusive feature.

If your dealer has not received his supply of Conaphores, write us.

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Noviol Glass	Per Pair	Clear Glass	Per Pair
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7 to 8½ inches incl.	3.50	7 to 8½ inches incl.	2.50
8½ to 10 inches incl.	4.50	8½ to 10 inches incl.	3.00
10½ to 11½ inches incl.	6.00	10½ to 11½ inches incl.	4.00

Prices 25c more per pair west of Rocky Mountains
Sizes vary by steps of ½ inch above 6½ inch size

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Range 500 ft.—No glare—Pierces fog and dust

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